IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF WEST VIRGINIA
AT CHARLESTON

OHIO VALLEY ENVIRONMENTAL COALITION, INC., WEST VIRGINIA HIGHLANDS CONSERVANCY, INC., and SIERRA CLUB,

Plaintiffs,

v. CIVIL ACTION NO. 2:13-5006

FOLA COAL COMPANY, LLC,

Defendant.

Huntington, West Virginia
August 19, 2014

TRANSCRIPT OF BENCH TRIAL - DAY 1
BEFORE THE HONORABLE ROBERT C. CHAMBERS
UNITED STATES DISTRICT JUDGE

APPEARANCES:

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Tuesday, August 19, 2014, at 9:10 a.m. in open court

THE COURT: All right. Are the parties ready to proceed?

MR. BECHER: Yes, Your Honor, plaintiffs are.

THE COURT: Before we get started with opening statements, on yesterday at a final conference, plaintiffs submitted two notebooks of joint exhibits.

My understanding is that the parties agree and stipulate that each of those exhibits is admissible and that the parties need not question witnesses to authenticate or otherwise have them introduced into evidence. Is that true?

MR. BECHER: That's our understanding. I would like to point out, I guess, one clarification, that I don't think we've agreed to the truth of all the matters in those documents. We can still argue about how valid they are. As far as admissibility, there should be no --

MR. MCLUSKY: That's right, Your Honor. So to the extent someone offers one in evidence, we may call them to ask for what purpose it's being offered.

THE COURT: All right. We're just stipulating their admissibility, then.

All right. Is there anything else we need to address before the opening?

MR. BECHER: Following up on that, Your Honor, we had reached a stipulation that was filed with the Court on the

materials prepared by Chris Swan, and these are contained in Joint Exhibits 11 through 16. Just to avoid the need to offer and separately admit those, we would like to, as a group, ask for those to be admitted at this point.

THE COURT: 11 through 17 in plaintiffs' exhibits?

MR. BECHER: Through 16 in the joint exhibits, Your Honor; 11 through 16 in the joint exhibits.

MR. MCLUSKY: No objection.

THE COURT: No objection? All right. They're each admitted.

MR. BECHER: One moment, Your Honor.

THE COURT: Go ahead.

MR. BECHER: And, Your Honor, we would like to do the same thing for the Hansen exhibits, Joint Exhibits 3 through 10.

THE COURT: All right. Any objection to those?

MR. MCLUSKY: No, Your Honor.

THE COURT: They're admitted.

All right. Are we ready for openings?

Go ahead.

MR. BECHER: Thank you, Your Honor. Through briefing the previous case, this Court is now well aware of the applicable law in this case. Fola's permit contains conditions prohibiting discharge that cause a violation of water quality standards. Plaintiffs will show that Fola has

violated narrative water quality standards in Stillhouse Branch of Twentymile Creek by discharging materials in concentrations that are harmful, hazardous, or caustic to man, animal, and aquatic life in violation of the water quality criteria contained in 47-2 -- or 47 of the West Virginia C.S.R. 2-3.2e.

Also, defendants are causing a violation of water quality standards by creating a condition which adversely altered the integrity of waters of the state and by creating adverse impacts to the chemical, physical, hydrologic, or biological components of the aquatic ecosystem in violation of 47 West Virginia C.S.R. 2-3.2i.

To prove that Fola has violated these standards and its permit, plaintiffs will rely on scientific literature written by EPA scientists and independent researchers demonstrating the effects of high conductivity mine drainage on aquatic organisms in Appalachian streams.

The findings in this literature are uncontroverted. There are no published articles that disagree or refute these conclusions.

Plaintiffs will further rely on the EPA conductivity benchmark and peer-reviewed articles published after the publication of the benchmark to support the conclusions of those documents. These papers subject the relationship between high conductivity and biological degradation have

heightened scrutinies for a formal causation analysis.

THE REPORTER: I'm sorry. Can you go slower?

MR. BECHER: Sure. The authors, principally Suter and Cormier, found not only that the relationship between conductivity and biological impairment was causal, but that it was not confounded by any of 12 different variable being analyzed, including habitat, organic enrichment, nutrients, sediment, pH, selenium, temperature, headwaters, lack of headwaters, catchment area, settling ponds, dissolved oxygen, and metals. Again, nothing in the benchmark or the subsequent published papers has been refuted or contradicted in the published literature.

The levels of conductivity in Stillhouse Branch are far in excess of those found to cause biological degradation in this literature. While the benchmark and the independent research establish a threshold level of 300 microsiemens per centimeter, levels in Stillhouse Branch are consistently well above 3000 microsiemens per centimeter.

Discharge monitoring reports confirm the level of conductivity correspond to concentrations discharged by Fola.

Now, the stream at issue in this case, Stillhouse Branch of Twentymile Creek, is composed entirely of flow from Outlet 29 of Fola's Surface Mine No. 3. The mine is the only source of pollution in the watershed. It's the only major disturbance in the area.

Stillhouse Branch is classified by the West Virginia Department of Environmental Protection as a stream impaired for not meeting biologic criteria; so is the next order stream, Twentymile Creek. There can be no doubt that Stillhouse Branch is impaired as a result of Fola's mining.

Plaintiffs will present direct testimony from two expert witnesses showing that this impairment is the result of conductivity. These experts are Dr. Palmer and Dr. Ryan King. Dr. Margaret Palmer has testified before this Court several times as an expert in stream restoration and aquatic ecology. She will provide the Court with an overview of the literature establishing that conductivity does indeed cause biological impairment.

She will explain how the level of review given to this relationship has been one of the most rigorous she has seen in her field. Dr. Palmer will then go on to explain the conditions of Stillhouse Branch as she observed them on her visit to the site. She will explain why evidence from the site leads to only one logical conclusion, that biological impairment at Stillhouse Branch was caused or contributed to by ionic pollution from Fola's surface mine.

Plaintiffs' next witness is Dr. Ryan King. Like Dr. Palmer, he's testified several times before this Court, and he has been qualified as an expert in ecology, entomology, and ecologic data analysis.

Dr. King will explain how EPA scientists such as Suter and Cormier have examined the evidence and determined through weight of evidence and statistical methods that conductivity does indeed cause biological degradation.

Dr. King will explain how his own work, how it validates EPA scientists. Dr. King will also address the site-specific evidence at Stillhouse Branch itself. He will describe how the stream has gone from a larger ecosystem to one dominated by organisms that are highly tolerant to ionic pollution.

Plaintiffs anticipate the defendant will call two witnesses of their own, Carrie Kuehn and Dr. Charles Menzie. Carrie Kuehn has no experience in the ecological methods -- in ecological methods, and it's admitted that she has not analyzed any of the data at issue in this case. Nonetheless, she will attempt to undermine the credibility of plaintiffs' experts and also the entire body of work demonstrating this causal link between conductivity and biological impairment in Appalachian streams. She'll do this primarily by pointing out that they did not follow a rigid approach favored by epidemiologists.

Defendant's next witness will be Dr. Charles Menzie. Like Carrie Kuehn, Dr. Menzie attempts to show not only the plaintiffs' experts but dozens of scientists who have been involved in the literature examining the link between conductivity and biological impairment, just a very basic fact

that calls into doubt the body of work.

It's worth noting Dr. Menzie did not have any problem with this work even though he served as one of the reviewers of the EPA benchmark until he was hired for this litigation.

Throughout this testimony, the Court should keep in mind the burden the plaintiffs bear in this case. This case must be decided on the preponderance of evidence, 51 percent likelihood that plaintiffs are correct. While Fola's experts struggle to find weaknesses in the literature and the work by plaintiffs' experts, by their own admission they have not gone through the necessary steps to determine any alternate cause of impairment for this stream.

Plaintiffs also need not show that conductivity is the sole cause of impairment. It is enough to violate the water quality standards when a discharge causes or contributes to the biological degradation of the stream.

The evidence in this case points in one direction only, that conductivity is the principal cause or at least a strong contributor to the degradation of Stillhouse Branch. Thank you.

THE COURT: Thank you. All right. For the defendant?

MR. HARVEY: Good morning, Your Honor. In addition to the counsel who've made an appearance in this case, we also have with us today Dr. Menzie, whom you know. Sitting beside

Dr. Menzie is Carrie Kuehn, the epidemiologist you've heard so much about already, and also with us today in the back is Mike Sweeney, in-house counsel for Fola Coal Company.

Your Honor, to prevail in this case, plaintiffs must show that Fola discharged a pollutant that caused a violation of West Virginia's narrative water quality standards. This raises two key questions: Is conductivity a pollutant that causes impairment, and did conductivity cause impairment at Stillhouse Branch? General causation and specific causation.

Plaintiffs answer the general causation question by relying heavily on the EPA benchmark for conductivity. As we discussed a couple of weeks ago, the benchmark marked a significant departure for the EPA. The Clean Water Act is over 40 years old; and throughout its history, EPA has always used laboratory data to set water quality standards. It takes test organisms, it exposes them to pollutants in a lab, it studies the results under very careful conditions, and it sets the standard after public notice and comment.

The benchmark was different. For the first time ever, the agency used observational data to set a standard. They took data that had been gathered by the West Virginia DEP and others and applied principles of epidemiology to study that data and reach conclusions on causation. This was a first for the agency.

And there's nothing wrong with using epidemiology to

answer questions about general causation. That is what epidemiologists do. They take observational date, they run very complicated statistics on that data, and they can infer a causation from it if the data is good data.

The link between smoking and lung cancer was established by epidemiologists. However, if you do not know what you are doing, if you're only dabbling in epidemiology, you can make mistakes. Relationships that seem appealing to the untrained eye can be misleading. Correlation is not causation. EPA and the plaintiffs' experts we believe have made mistakes in that regard.

In this case, you will hear that EPA made mistakes in their maiden voyage into the field of epidemiology. You will hear that plaintiffs made mistakes.

The second question imposed in the case is whether conductivity caused impairment at Stillhouse. I'd like to show you a picture of Stillhouse, if I could, Mr. Tyree, just to orient the Court.

Your Honor, Stillhouse Branch has been largely filled -- its headwaters have largely been filled by a valley fill that is not in the picture, but you will see that the water runs through the valley fill and into a series of sediment ponds. The Court has seen sites like this before and is familiar with them. There's a series of three to four ponds at the top of that picture.

From there, the water runs down a steep concrete flume into a short open stream channel. At the end of that flume, at the beginning of that channel is where the plaintiffs conducted their WVSCI sampling and their habitat sampling. The water then runs through a series of pipes and ditches until it finally dumps into Twentymile Creek.

Your Honor, many of the physical conditions shown in this photograph are known to cause stream impairment. In fact, plaintiffs' experts have testified on many occasions, including before this Court, that the conditions seen in this photograph will cause impairment without regard to the chemical quality of the water. Plaintiffs, however, have not taken these site conditions into account in their site-specific analysis.

Your Honor, we realize that this case appears similar in many ways to the case you heard last December, the *Elk Run* case. We ask that you remember that the benchmark is still relatively new science. The papers that supported the benchmark by Suter and Cormier were published just last year.

In the last trial, we did not seek to attack the underpinnings of the benchmark, but we plan to do so in this case. Science evolves only because we continue to ask questions, continue to probe, continue to have an open mind; and we ask that the Court have an open mind in this case. Thank you.

THE COURT: Thank you.

All right. Plaintiffs ready to call their first witness?

MR. LOVETT: We are, Your Honor. We call Dr. Margaret Palmer, please.

MR. MCLUSKY: Your Honor, before we start, we've had discussions with plaintiffs' counsel. You may recall in the last case, we moved to sequester the plaintiffs' other experts during the cross-examination of Expert A; that is, Expert B would be sequestered during the cross-examination. We intend to do the same, and they intend to make the same motion with respect to our experts, as I understand it.

THE COURT: All right.

MR. LOVETT: That's my understanding as well, Your Honor.

THE COURT: All right.

MR. MCLUSKY: Then Dr. King would have to step out when Dr. Palmer is cross-examined.

THE COURT: All right. Then the Court will instruct the parties to follow that rule accordingly. So each side's experts may not sit in on the cross-examination of their client's other expert.

MARGARET PALMER, PLAINTIFFS' WITNESS, SWORN

DIRECT EXAMINATION

BY MR. LOVETT:

Q. Good morning, Dr. Palmer.

A. Good morning.

Q. So we're going to be working with a series of notebooks, and I think there are three notebooks that you'll need to have in front of you for the examination. They are two joint exhibit notebooks and plaintiffs' exhibit notebooks.

Does the clerk have a copy of those that the witness can use?

THE COURT: Do you want the witness to use the original? I think we had requested a copy for me, a copy for my law clerk, and the original, or a copy that was given to the clerk would suffice as the original.

MR. LOVETT: Let me see if we have another copy, Your Honor.

THE COURT: All right.

MR. LOVETT: We do not. The witness would have to use one of those three, whichever the Court --

MR. BECHER: Your Honor, if I may, we submitted four copies to the Court yesterday. So there should be a copy for you yourself, Your Honor, each of your two law clerks, and then a set of originals as well. So four copies in total.

THE COURT: Okay. Do we need to use, then, a copy that was provided to one of my law clerks for the witness to use?

THE CLERK: They're not marked. I'm just going to mark them later anyway.

THE COURT: All right.

MR. LOVETT: Thank you.

THE WITNESS: This is the first one we'll use?

BY MR. LOVETT:

Q. Dr. Palmer, would you turn to Joint Exhibits 1 to 58, Exhibit 17.

A. Yes.

Q. Do you see that?

A. Yes.

Q. Is that your CV?

A. It is.

Q. Did you prepare the CV yourself?

A. Yes.

Q. Is it an accurate representation of your experience?

A. It is.

Q. Have you testified before this Court before?

A. Yes, I have.

Q. Several times; is that right?

A. That's correct.

Q. And you've been admitted as an aquatic ecologist and stream restoration expert in the past; is that correct?

A. Correct.

Q. Are you still a professor at the University of Maryland?

A. I am.

Q. And do you conduct research at the University of

Maryland?

A. Yes. I have a laboratory and graduate students and so forth.

Q. And are you in charge of the laboratory?

A. I am.

Q. And what is the focus of that laboratory?

A. Stream ecology, including studies related to insects, as well as biogeochemistry.

Q. Okay. Is the work that you carry out in your research relevant to your testimony here?

A. Oh, yes.

Q. Okay. And do you supervise graduate students as part of your work?

A. I do.

Q. How many graduate students are you currently supervising?

A. Right now I have five graduate students.

Q. Can you give me an idea of about how many publications you've authored in peer-reviewed journals in the field of aquatic ecology?

A. Somewhere around 153 to 155.

Q. All in peer-reviewed journals?

A. Yes.

Q. And in addition to your research duties at the lab we discussed, do you also run something called the Socio-Economic Synthesis Center?

A. Socio-Environmental Synthesis Center.
Q. I'm sorry.
A. That's okay.
Q. And how is that funded?
A. It's funded by the National Science Foundation, a grant to me.
Q. How large is the grant?
A. Well, for the first five years, it was -- this is terrible. I'm having trouble remembering. I think 27 and a half million dollars.
Q. And how many people do you supervise at that research center?
A. Well, we have 16 staff members. I also supervise 10 post-docs there, and then we have approximately 500 visiting scholars a year that work at the center.
Q. And is that center's work related to stream ecology?
A. No --
Q. Just --
A. -- it's a whole variety of issues related to the environment.
Q. Okay. Is stream ecology among those?
A. I'm -- I'm sure -- yes, I am sure there are a few studies that include a focus on streams or rivers.
Q. What is the purpose generally of the center?
A. Well, the purpose of the center really is to gain a

better understanding of the relationship between people and social drivers and environmental factors, particularly issues that may have some policy relevance.

Q. Okay. So you now have feet in two worlds in a sense. You're still doing your aquatic research, correct?

A. Correct.

Q. You're also working on how science is related to policy issues at the center.

A. That's correct.

Q. Now, have you written papers on the effects of ionic stress on impaired streams?

A. Yes, I have.

Q. How many?

A. Well, the primary paper was the one that was focused on -- it came out in 2010, but there's at least one other one.

Q. What's the other one?

A. It's one that was just accepted for publication, and it looks at the outcome from all of the mitigation projects in the coal mining regions of the Appalachians based on data -- the database we put together from the reports submitted by coal companies to the Army Corps of Engineers.

Q. When was that published?

A. It was accepted for publication yesterday, and it's already online.

Q. Okay. In what journal?

A. *Environmental Science and Technology*.
Q. A peer-reviewed journal?
A. Yes.
Q. It's a journal we've heard a lot about in this courtroom over the years, isn't it?
A. That's correct, because it's a journal that deals particularly with issues related to the environment and chemical factors.
Q. Okay. Have you delivered talks about the impacts of ionic pollution or ionic stress on Appalachian streams?
A. Yes. I've delivered a number of talks related to that.
Q. Have you kept up with the literature related to ionic stress in Appalachian streams?
A. Yes. It's something I follow very carefully, particularly since I publish in that area.
Q. Do you consider yourself an expert in that area?
A. I think so, yes.
Q. In the course of your work, have you visited Appalachian streams?
A. I have.
Q. And how many times in your life do you think you've been in the streams of Appalachia?
A. Well, probably hundreds of times because I grew up in that area.
Q. Okay. And would you say that you have a familiarity with

the physical and other characteristics of Appalachian streams?
A. Absolutely.
Q. Can you generally tell, do you think, when a stream is healthy and when it's not?
A. I mean, generally speaking, if it's a physical cause, it's pretty obvious. If it's chemical, you have to do some sampling and look at the bugs in the stream and so forth unless you do water chemistry.
Q. And have you sampled benthic macroinvertebrates in Appalachian headwater streams?
A. I have.
Q. Would you say that you have a familiarity, a working familiarity with the types of aquatic insects that live in Appalachian streams?
A. Yes, I would.
MR. LOVETT: At this point I move to qualify Dr. Palmer as an expert in aquatic ecology, particularly as it relates to ionic stress in headwater streams, as well as -- well, that's all.
THE COURT: All right. I'm satisfied. Go ahead. The defense can cross-examine as to her qualifications.
MR. LOVETT: Thank you.
BY MR. LOVETT:
Q. Have you reviewed the data that will be used in this case regarding Stillhouse Branch?

A. Yes, I have.
Q. And what conclusion has that data led you to?
A. The data clearly show that the stream is biologically impaired and that there are very high levels of conductivity and sulfate and in some cases selenium.
Q. And do you believe that those high levels of conductivity and sulfates are causing the impairment in Stillhouse Branch?
A. Yes, I do.
Q. Okay. Let me ask you how you define "impairment."
A. Well, impairment is based on water quality criteria, and all states develop their own water quality criteria for submitting information to EPA for the 303(d) listing; and in West Virginia, that the West Virginia Stream Condition Index is used.
Q. Also known as the WVSCI, right?
A. That's correct.
Q. Okay. And so does EPA use the WVSCI method, or does it recommend use of the WVSCI method?
A. Well, EPA actually recommends use of something that is much more accurate, and that would be the GLIMPSS method, which was developed by Greg Pond at EPA.
Q. And what is the difference between WVSCI and GLIMPSS?
A. The WVSCI index is based on family-level criteria for the insects, whereas the GLIMPSS is based on genus-level criteria. And so for that reason, the genus-level one provides a much

better indicator of whether or not a stream is stressed.

Q. Would the GLIMPSS method be more sensitive about picking up harm to aquatic life than the WVSCI would be?

A. Yes, that's correct, because within a single family of insects, you can have both tolerant and sensitive genera. And so it's important to look primarily at those sensitive organisms if you want to protect the stream from impairment.

Q. Okay. And what is the measure of impairment, if you know, in the WVSCI index?

A. You mean the numeric value?

Q. Yes.

A. 68.

Q. Anything --

A. Below that would be impaired.

Q. Okay. Would you explain generally how the indices, both the GLIMPSS and the WVSCI, work?

A. Well, they're both essentially multi-metric indices. So a number of different subindices are used to develop those, and they include things like the number of EPT taxa, the percent of EPT taxa, the percent of organisms in the samples that are dipterans, typically midges. So a variety of different elements go into them.

THE COURT: Are all these subindices based upon or related to some type of aquatic life, specific organism of some type?

THE WITNESS: That's correct.

BY MR. LOVETT:

Q. Okay. So if a stream is impaired, you have different groupings of insects than you would find in an unimpaired stream.

A. That's correct, yes.

Q. Okay. And how does the change in population affect the overall ecology of the aquatic environment?

A. Well, whenever you change the population, for example, as significantly as in Stillhouse Branch, you can be missing whole categories of species or genera that perform different functions in the system. And so it could influence things like decomposition rate, metabolism, primary production if the organisms that are lost are consuming a fair amount of algae. So there are a lot of different ways. Certainly it can influence availability of prey for higher trophic levels.

Q. Now, in this case we're concerned with ionic pollution from alkaline mine drainage; is that right?

A. Yes, that's correct.

Q. And what is alkaline mine drainage?

A. It simply refers to the fact that the water is alkaline itself, the pH is typically above 7, and that's characteristic of this particular region in the Appalachians.

Q. And does the alkaline mine drainage that exists at Stillhouse, is that somehow related to ionic pollution?

A. It is. So the elevated conductivity is essentially a measure of the ions that are in solution. It does that by measuring electrical conductivity.

Q. So when we talk about conductivity, you're talking about -- tell me what conductivity is.

A. Well, it's a measure of -- actually, technically it's a measure of current flowing through the water, but that's related to the ions that are dissolved in the water. And so as conductivity goes up in these streams, it's because you have elevated levels of things like iron, sulfate, calcium, magnesium, etcetera.

Q. So is it fair to say that we know from the conductivity levels in Stillhouse that sulfates are being discharged at high levels from the outfall?

A. That's correct. The sulfate levels were very elevated.

Q. Okay. Could you describe the relationship the best you can between sulfates and high conductivity?

A. In this part of the Appalachians because of the geology of the region and so forth, the sulfates pretty much mirror conductivities. So, in fact, West Virginia DEP had been using sulfate concentrations as a proxy for mining previously when you get above about 50 milligrams per liter.

Q. Okay. So what is actually -- if you can answer this, what's actually causing the impairment? Is it the sulfates, the conductivity, the mixture of them?

A. It's believed to be the mixture of them, and it's when you get -- you can think of it almost like salinity. Say you get significant ions in the water and it causes ionic -- some kind of ionic stress on the organisms.

Q. How is this -- how are these sulfates and high conductivity created by the surface mine?

A. So when the material is brought up from great depths to do the mining, the -- and the valley fills are created, you're exposing rock material that hasn't been really exposed to water and oxygen and so forth on the surface in a very, very, very long time.

And so when it rains, water flows through that overburden material in the valley fill. It forms acidic conditions initially, hydrogen -- hydrochloric -- hydro -- sulfuric acid. Excuse me. And -- but that's really quickly neutralized because there's significant calcium ions and so forth, bicarbonate, that forms that can neutralize that.

Q. Okay. And this whole soup creates the alkaline mine drainage that you mentioned earlier, right?

A. That's correct.

Q. Okay. And are there aquatic insects that are particularly sensitive to this kind of pollution?

A. Mayflies are the most sensitive. They're sensitive in general, but in the case of the elevated conductivity in these streams, numerous studies have shown that they decline or

completely disappear as conductivity increases.

Q. Okay. And has the relationship between surface mining and alkaline mine drainage or ionic stress been clearly established in the literature?

A. Oh, absolutely. Many, many studies have established that relationship.

Q. Okay. And have many studies also been published that show the effects of alkaline mine drainage, particularly the sulfates and conductivity, on aquatic organisms?

A. Yes, there have been a number of studies that looked at the relationship between taxonomic composition, in some cases the WVSCI scores or the GLIMPSS, and conductivity.

THE COURT: Let me ask a question before we get too far. What stream functions are lost or diminished as a result of injury to sensitive species or insects?

THE WITNESS: Well, there's a variety of ones. The most obvious one would be availability of prey to higher trophic levels.

So, for example, bats feed on emerging insects from these streams. Birds feed on emerging insects.

MR. MCLUSKY: Your Honor, I hate to object to the Court's question, but this is outside the scope of her report. She's offered no report or opinion on impacts beyond those to the insects themselves.

THE COURT: Well, I haven't seen her report. Is

that a fair statement?

MR. LOVETT: I'm thinking about the report, Your Honor. I need one second, if you don't mind.

THE COURT: All right.

THE WITNESS: But I can also talk about impacts that are just --

MR. LOVETT: Let's wait until --

THE COURT: Hold on.

MR. LOVETT: Your Honor, Dr. Palmer's report does not address issues of function beyond the loss of the insects themselves.

THE COURT: Well, in what regard does it address function affected by the loss of insects?

MR. LOVETT: Only I think and to this extent, that she testified earlier that certain functions of the insects themselves that are lost, shredding and the other kind of activities that the insects carry on in the water itself is lost, not the effect on higher trophic levels.

THE COURT: All right. Go ahead. Resume your questioning you started before I interrupted you.

THE WITNESS: I don't know if I can correct you, but higher trophic levels are affected within the stream.

MR. LOVETT: I understand, but --

THE WITNESS: I don't mean --

MR. LOVETT: You don't need to testify about that --

THE WITNESS: Okay.

MR. LOVETT: -- given the Court's ruling.

MR. MCLUSKY: Your Honor, I move to strike the comment.

THE COURT: Well, I'll disregard it.

BY MR. LOVETT:

Q. Do the insects in the streams vary over insensitivity?

A. Yes, they do.

Q. And the presence and absence of those insects, then, allows stream ecologists to determine whether a stream is healthy or not; is that correct?

A. That's correct.

Q. Now, I was asking you, I think, about the publications in the area.

A. Yes.

Q. And particularly about the effects of sulfates and conductivity on aquatic life.

A. Yes.

Q. Do you know approximately how many publications, peer-reviewed publications there have been that address that relationship?

A. I want to say on the order of perhaps 20.

Q. Are you confident that that number is close?

A. Yes.

Q. Did you just look at that this morning?

A. I did look at it, but I don't remember the exact number. I actually counted the authors.

Q. And how many authors were there of those approximately 20 papers?

A. Over 50.

Q. So over 50 authors have published approximately 20 papers in peer-reviewed journals addressing the relationship between conductivity, sulfates, and aquatic impairment; is that right?

A. That's correct. So those are the papers that are just linking conductivity and impairment. It doesn't include papers linking valley fills to conductivity alone.

Q. And there are many more of those papers, right?

A. That's correct.

Q. Now, and do each of those papers determine that there is a link -- strike that.

Do each of those papers determine that conductivity -- that high conductivity causes aquatic impairment?

A. They all show a strong relationship between conductivity and impairment.

Q. And are there any papers, published papers, to the contrary?

A. No, no papers to the contrary.

Q. Okay. And at what levels do those papers determine -- at what levels of conductivity do those papers determine that aquatic impairment occurs?

MR. MCLUSKY: Your Honor, I'm going to object. I'm looking at her report. She's got 11 documents listed here as reference materials on page 9 and 10 of her report, and we've just talked about some 20 articles that haven't been identified and are not identified presumably in this list of 11 reference materials.

MR. LOVETT: Well, she's not testifying specifically about each of them. I think there's also a list on the rebuttal report. I agree that perhaps each of the 20 isn't something she's going to testify any more about. Mr. McLusky can ask her, if he likes, to name each of the 20 articles and to see if -- you know, test her knowledge of them.

THE COURT: Well, I assume what you're telling me is that for purposes of forming her opinions, she's relied upon the articles that were listed specifically that totaled about 11.

MR. LOVETT: Eleven in her opening report and then the additional articles in her rebuttal report.

THE COURT: All right. You don't intend to ask her about any articles other than those listed, apart from asking her how many articles she's aware of have been published in the area?

MR. LOVETT: That's correct, Your Honor.

THE COURT: All right. Then I deny the objection. Proceed.

BY MR. LOVETT:

Q. The Court has heard this before, and I'll move through it as quickly as I can, but I think we should go through a bit of the history of the publication of papers showing the relationship between conductivity and stream impairment.

So are you aware of a Greg Pond paper that was published in 2008?

A. Yes.

Q. Can you explain the significance of that paper to me?

A. Well, he and co-authors basically showed that below valley fill sites -- so they compared mined and unmined sites and showed that conductivity was much higher in the mine below the mine sites and also that there was a loss of organisms.

Q. Okay. If you could turn to Plaintiffs' Exhibits 1 to 26 notebook.

May I approach, Your Honor?

THE COURT: You may.

MR. MCLUSKY: I'm sorry, Joe. Which number was it?

MR. LOVETT: It's plaintiffs' notebook, Exhibits 1 through 26.

BY MR. LOVETT:

Q. Let's start with Exhibit 1. Are you familiar with this paper?

A. Yes, I am.

Q. And would you tell us what this paper is.

A. This is a paper that Dr. Bernhardt and I wrote summarizing all the impacts of mountaintop mining valley fill operations, including what happens to other water chemistry and to the biota.

Q. And when was it published?

A. When or where?

Q. When.

A. It was published in 2011.

Q. And where was it published?

A. It was published in the New York Academy of Science's journal.

Q. Could you turn to -- we'll use these PE numbers at the bottom. It's PE 24. Or, excuse me. PE 14. Do you see the numbers I'm referring to?

A. Okay.

Q. And do you see in the conclusions there?

A. I do.

Q. Could you read into the record at the conclusion from the sentence about, you know, a couple inches down beginning "Whether or not."

A. "Whether or not individual component ions within mining-derived runoff reach streamwater concentrations" --

THE REPORTER: I'm sorry.

THE COURT: Slow down.

THE WITNESS: I'm sorry. "Whether or not individual

component ions within mining-derived runoff reach streamwater concentrations of multiple contaminants is clearly associated with a substantial reduction in water quality and biological integrity in streams and rivers below mine sites."

BY MR. LOVETT:

Q. And the next sentence as well, please.

MR. MCLUSKY: What page are we on?

MR. LOVETT: PE 14.

MR. MCLUSKY: Which column?

MR. LOVETT: At the conclusions. We're now in the last sentence on the page.

MR. MCLUSKY: Thank you.

THE WITNESS: "All research to date indicates that conductivity is a robust measure of the cumulative or additive impacts of the elevated concentrations of multiple chemical stressors from mine sites that lead to biological impairment of streams."

BY MR. LOVETT:

Q. And you believe that statement was accurate as of the publication in 2011?

A. Yes, I do.

Q. Do you still believe that to be an accurate statement?

A. Absolutely.

Q. Is that a peer-reviewed journal?

A. Yes, it is.

Q. Okay. Could you turn to Exhibit 3, please.
A. Okay.
Q. Have you seen this paper before?
A. I have.
Q. And who were the authors of the paper?
A. Susan Cormier, Glenn Suter, and Lei Zheng.
Q. And where was it published?
A. It was published in *Environmental Toxicology and Chemistry*.
Q. And what year was it published?
A. 2012.
Q. Is that a reputable peer-reviewed journal?
A. Absolutely.
Q. Okay. Can I turn your attention to the abstract, please.
A. Yes.
Q. Could you read from the sentence "The authors developed an aquatic life benchmark." Do you see that?
A. Yes.
Q. Could you read --
A. "The authors developed an aquatic life benchmark for specific conductance as a measure of ionic strength that is expected to prevent the local extirpation of 95 percent of species from neutral to alkaline waters containing a mixture of dissolved ions in which the mass of sulfate, bicarbonate, and chloride."

Q. Would you continue, please.
A. "Extirpation concentrations of specific conductance were estimated from the presence and absence of benthic invertebrate genera from 2,210 stream samples in West Virginia."
Q. Continue.
A. "The extirpation concentration is the 95th percentile of the distribution of the probability of occurrence of a genus with respect to specific conductance."
Q. And one more sentence.
A. "In a region with a background of 116 microsiemens per centimeter, the 5th percentile of the species sensitivity distribution of extirpation concentrations for 163 genera is 300 microsiemens per centimeter."
Q. Okay. Do you agree with that conclusion?
A. Yes, I do.
Q. Does all of the published literature that you're aware of agree with that conclusion?
A. Yes, it does. They do.
MR. MCLUSKY: Your Honor, I object to this only because it refers to genera, and I think her own testimony was that the measure of impairment in West Virginia is tied to taxa, not genera.
THE COURT: Well, you can cross-examine her about that.

BY MR. LOVETT:

Q. Would you turn to Exhibit 11, please.

A. Okay.

Q. What is Exhibit 11?

A. This is a paper by a group of people, Ty Lindberg, Emily Bernhardt, and others looking at the cumulative impacts of mining in a watershed.

Q. And when was that paper published?

A. This was published in, I think, 2011.

Q. I think it says -- does it say received for review July --

A. So it could be it could have come out in final form in 2012. I'm not sure when the final form came out.

Q. Okay. Where was this published?

A. This was published in *Proceedings of the National Academy of Science*.

Q. Is that a prestigious journal?

A. One of the most prestigious.

Q. Okay. And could I turn your attention to the abstract on the first page there.

A. Yes.

Q. And about halfway down, the sentence beginning "However, as eight separate mining." Do you see that?

A. "However, as eight separate mining-impacted tributaries contributed their flow, conductivity and the concentrations of

selenium, sulfate, magnesium, and other inorganic solutes increased at a rate directly proportional to the upstream areal extent of mining."

Q. Okay. And then skip a sentence and read the sentence, if you would, beginning "All tributaries."

A. "All tributaries draining mountaintop-mining-impacted catchments were characterized by high conductivity and increased sulfate concentration, while concentrations of some solutes such as selenium, strontium, and nitrogen were lower in the two tributaries draining reclaimed mines."

Q. Okay. Now, you've examined the data from Stillhouse Branch, correct?

A. Correct.

Q. And we'll go through that in a minute, but do the data from Stillhouse Branch comport with the conclusion here that tributaries draining mountaintop-mining-impacted catchments were characterized by high conductivity and increased sulfates?

A. Yes, that's correct.

Q. And do you agree with the conclusions of Drs. Lindberg et al. here?

A. Yes, I do.

Q. I turn your attention to Exhibit 13, please.

A. Okay.

Q. Do you recognize that?

A. I do.
Q. And what is it?
A. It's a paper that I was the lead author on, published in *Science* in 2010, looking at the consequences of mountaintop mining.
Q. Okay. And is *Nature* a prestigious journal?
A. Is the *Science*?
Q. I'm sorry. *Science*.
A. Yes.
Q. Is that a prestigious journal?
A. It's a very prestigious journal.
Q. And this is peer-reviewed, correct?
A. Yes.
Q. Turning your attention to page PE 177, which is the next page --
A. Okay.
Q. -- and the first section there is "Mining effects on stream chemistry and biota." Do you see that? I think it's explaining the figures above.
A. I'm sorry. What column are you --
Q. It's the first -- it's the very first thing, describing the figures.
A. Oh, it's the figure legend. Okay. "Mining effects on stream chemistry and biota. Sulfate concentrations reflect amount of mining in watershed." That's the top panel.

Q. Right.
A. Average concentrations of manganese, iron, aluminum, and selenium is the bottom panel.
"Stream invertebrate metrics in relation to sulfate concentrations for 1058 West Virginia streams (methods in table S2). Regressions all statistically significant (table S3)."
Q. What do those panels tell you?
A. Well, this -- that shows that -- this was before the benchmark was established.
Q. Yes.
A. And we looked at the relationship between increasing sulfate and other ions, as well as the stream condition index. The ions we looked at all increased, and the stream condition index declined, as did the number of insect genera, the number of intolerant genera, and the number of mayfly genera.
Q. And in 2014 do those conclusions hold true still?
A. Yes, they do.
Q. Okay. I turn your attention to tab 15, please.
A. Yes.
Q. What is that?
A. This is the paper by Greg Pond that we talked about earlier in my testimony.
Q. The 2008 paper?
A. Correct.

Q. Okay. And let's look at the abstract there and start with the second sentence "We characterized."

A. "We characterized macroinvertebrate communities from riffles in 37 small West Virginia streams (10 were unmined and 27 mined sites with valley fills) sampled in the spring index period (March through May)" --

Q. May I interrupt you there?

A. Yes.

Q. So this is different -- is this different from the other papers that you've testified about in that it's focusing on particular streams?

A. That's correct.

Q. Okay. And I forgot to ask you, was this published in a peer-reviewed journal?

A. Yes. It's in the *Journal of the North American Benthological Society*.

Q. Another reputable journal?

A. Yes. It is the top stream ecology journal.

Q. Okay. And could you read one more sentence. If you skip a sentence, then it's the sentence beginning "Four lines of evidence."

A. "Four lines of evidence indicate that mining activities impair biological condition of streams: shift in species assemblages, loss of Ephemeroptera taxa, changes in individual metrics and indices, and differences in water chemistry."

Q. Okay. Now, this publication is from 2008. Do those conclusions hold true today?
A. They do.
Q. And they're supported by all subsequent published literature; is that correct?
A. That's correct.
Q. Does it matter -- is it relevant that this focuses on particular streams instead of a large dataset from DEP?
A. Well, it reaches the same conclusion. It just has groups of streams as opposed to, say, a continuum.
Q. It uses different methods to reach the same conclusion that the DEP dataset led other researchers.
A. That's correct.
Q. Could you turn to Exhibit -- or tab 16, please.
A. Okay.
Q. Well, before we do that -- I'm sorry. Back in that article, would you look at PE 212. PE 213. I'm sorry.
A. Okay.
Q. Do you see table 5 there?
A. Yes.
Q. What does table 5 show us?
A. This shows you correlation coefficients for both the GLIMPSS --
Q. Okay.
A. -- index and the WVSCI index and the significance of

those various factors related to that.
Q. And does it address temperature?
A. Yes, it does.
Q. Does it find temperature to be significant?
A. Not to significantly affect.
Q. What does it find? Let's look at the WVSCI rather than the GLIMPSS. Do you see the WVSCI column?
A. Yes.
Q. What effect does -- how much of the effect of impairment does the temperature contribute to?
A. .02.
Q. That's a very small amount, correct?
A. Very small.
Q. And --
A. Conductivity, eight -- .80.
Q. And does it also address embeddedness?
A. Yes. That's .22.
Q. So it finds -- this study finds that at those mined sites, conductivity is a much, much more significant cause than either embeddedness or temperature.
A. That's correct.
Q. Does that mean that this 2008 paper did not find that either temperature or embeddedness were confounding factors for the causation of the impairment by conductivity?
MR. MCLUSKY: I object. There's no foundation for a

statement about a confounding factors analysis.

THE COURT: Rephrase your question.

BY MR. LOVETT:

Q. What's a confounding factor?

A. A confounding factor is a factor that essentially interferes with the relationship between two other variables you're trying to look at.

Q. And is that a statistical concept that you use in your work all the time?

A. Yes.

Q. Okay. And based on these tables, does it appear that either temperature or embeddedness confounds the causal mechanism of conductivity for impairment?

MR. MCLUSKY: I object to the form of that question. The testimony earlier was there's a high degree of correlation between conductivity and impacts to insects, not causation.

MR. LOVETT: That's not my question. I am not asking about the relation -- I'm asking if she thinks this shows cause or not.

THE COURT: Overruled. You can cross-examine.

THE WITNESS: I'm sorry. What was the question?

BY MR. LOVETT:

Q. I'm sorry. Let me try to think of it again. Does this show -- does this table show that conductivity is the cause of the impairment rather than temperature or embeddedness?

A. It does. It shows it's the primary leading factor.
Q. Let's see. Turn to 16 now, please. What is tab 16?
A. Yes.
Q. What is that?
A. This is another study by Greg Pond, as sole author this time, looking at what happens to mayflies, Ephemeroptera, in headwater streams, patterns of taxa loss.
Q. Okay. And where was this published?
A. It was published in *Hydrobiologia*.
Q. Do you know when it was published?
A. I want to say 2012. I'm looking to see if it's on here. This is the proof instead of the final article that was published, but it's essentially the same.
Q. Okay. Could you --
A. Oh, it may have been 2010. I'm sorry.
Q. Why do you say that? Why are you changing your mind?
A. Well, because what I'm looking at was the final version was accepted December 2009. So it certainly had a 2010 date on it.
Q. Okay. Now, in the abstract there, at the end of the abstract, at the end of the first column on page 223, there's a sentence that begins "Mean mayfly richness." Do you see that?
A. Yes.
Q. Would you read that, please?

A. "Mean mayfly richness and relative abundance were significantly higher at reference sites compared to all other categories; mined sites had significantly lower metric values compared to residential and mined and residential sites."

Q. Okay. So what conclusion is Pond drawing here?

A. Well, he's basically concluding that the abundance of mayflies declines dramatically in mined streams even in comparison to watersheds that have a little bit of mining and residential development in them.

Q. Okay. And do you agree with the conclusion of the paper?

A. I do.

Q. Has any subsequent publication invalidated that paper?

A. No, they have not.

Q. Number 17, please.

A. Yes.

Q. What is that?

A. This is a similar paper by Greg Pond, but in this case he looked at the effect of mining on stoneflies and caddisflies.

Q. Okay. Can I turn your attention to the abstract and the very bottom of the first column with the sentence beginning "Core caddisfly genera." Do you see that?

A. Yes.

Q. Could you read that sentence? Read that sentence and the following, please.

A. "Core caddisfly genera" -- do you want me to read all

those?

Q. No.

A. -- "were extirpated from most disturbed sites. Species richness was significantly higher at reference sites and reference site mean tolerance value was lowest compared to all other categories; relative abundance of both orders was variable between disturbance groups."

Q. Okay. What does that tell us, that abstract?

A. Well, basically it's similar, that when you get disturbance in a watershed, you can get a reduction in stoneflies and caddisflies, but the greatest reduction is in the mined sites.

Q. Okay. And so that is looking at a particular mine site or a large dataset?

A. I believe this was looking at particular mine sites, but I'd have to go back. They looked at 94 headwater streams, and they were groups of sites.

Q. And is this in Kentucky? Are these data from Kentucky?

A. That's correct.

Q. And was -- where was it published?

A. This was also published in *Hydrobiologia*.

Q. Do you agree with the conclusions reached in that paper?

A. Yes, I do.

Q. Have all subsequent publications also been in harmony with that paper?

A. Yes, they have.
Q. Okay. I turn your attention to tab 18, please.
A. Okay.
Q. What is that?
A. This is a very -- oh, this is a paper by Greg Pond, Jeff Bailey, Ben Lowman, and Michael Whitman that describes how the GLIMPSS index was developed, calibrated, and validated.
Q. Okay. Would you read the sentence in the abstract, in the second column, beginning "A comparison of GLIMPSS with WVSCI."
A. "A comparison of GLIMPSS with WVSCI exhibited marked improvements where GLIMPSS detected greater stream impacts."
Q. What does that mean?
MR. MCLUSKY: Your Honor, before we go any further, I've looked at both her first report and then the rebuttal report. I don't think this paper is listed as a reference in either report.
MR. LOVETT: If it's not, I apologize and we'll move on.
THE COURT: Well, why don't you move on --
MR. LOVETT: I'll look to make sure.
BY MR. LOVETT:
Q. Okay. Can I turn your attention to PE 287, which is tab 19, please.
A. Yes.

Q. Now, this isn't mentioned in your report, is it?

MR. HECKER: It is.

MR. LOVETT: Oh. Well, Mr. Hecker informs me -- strike that. Let's move back to the previous thing. Mr. Hecker informed me on page 10 of her report from January 16, 2014, it is listed as the -- I guess it's the first --

MR. MCLUSKY: Okay. It's there, Your Honor.

THE COURT: All right. Go ahead, then.

BY MR. LOVETT:

Q. Okay. Well, let's go back and try to finish that. What does -- what's the conclusion of this calibration and validation paper that begins on PE 261?

A. Well, it basically is just demonstrating, showing, how they developed it and that it is better at detecting impairment in streams, loss of taxa, and so forth than is the WVSCI score.

Q. All right. So let's move on to the next one, which is PE 287. Do you see that?

A. Yes.

Q. And that's not listed in either of your reports, is it?

A. This came out right -- very recently.

Q. Okay.

A. And so I wanted to submit it as something I had read.

Q. When was it published?

A. 2014.

Q. June 2014?
A. That sounds about right.
Q. This says accepted June 2014. So very recently.
A. Yes.
Q. And who are the authors?
A. Greg Pond and colleagues from other -- from EPA.
Q. Okay.
A. And actually from the Office of Surface Mining.
Q. From EPA and the Office of Surface Mining?
A. That's correct.
Q. Where was it published?
A. In *Environmental Management*.
Q. Is that a peer-reviewed journal?
A. Absolutely.
Q. And what does the paper conclude?
A. There's a number of different conclusions. I think that among the most significant is that they looked at streams below valley fill sites where the sites had been reclaimed, and it was between, like, 11 and 33 years previously; and those streams, the majority, the vast majority were still impaired.
Q. Eleven to thirty-three years after the completion of reclamation, a majority of the streams were still impaired; is that right?
A. That's correct.

Q. Impaired by what?

A. Conductivity, ionic problems, water quality.

Q. And would you read from the abstract at the end of the first column where it says, "Although valley fills -- although VF sites." Do you see that?

A. "Although valley fill sites had good instream habitat, nearly 90 percent of these streams exhibited biological impairment. Valley fill sites with higher index scores were co-located near unaffected tributaries; we suggest that these tributaries were sources of sensitive taxa as drifting colonists."

Q. What does that mean?

A. So what they did in this study was they selected sites that had comparable temperature and habitat regimes to the reference sites, and the majority of the mined sites were impaired and had water quality problems. There were a few that were below the impairment threshold. And so they went back into the field to sample tributaries that were contributing to the stream they sampled, and those tributaries were unmined, and measured drifting organisms.

And what they found was, not surprisingly, from those unmined tributaries, organisms were drifting in to the main stem -- I guess it was the main stem that they were sampling below the valley fill. And so basically what they showed is that the exceptions to the -- what I would call a rule, that

when conductivity reaches a certain point you get impairment, were due to drifting organisms coming in.

Q. Okay. And let's look at the last sentence of the abstract, "Although these VFs," valley fills. Do you see that?

A. "Although these valley fills were constructed pursuant to permits and regulatory programs that have as their stated goals that (1) mined land be reclaimed and restored to its original use or a use of higher value, and (2) mining does not cause or contribute to violations of water quality standards, we found sustained ecological damage in headwater streams draining valley fills long after reclamation was completed."

Q. Okay. I turn your attention to PE 289.

A. Yes.

Q. And I guess it's a sentence that begins, really, on 288, but it's a very long sentence. So -- no. Strike that. It's not.

Do you see the first sentence, beginning "Local reference streams"?

A. Yes.

Q. Would you read that sentence, please.

A. "Local reference streams were sighted in close proximity (range .75 to 10.5 kilometers) to paired valley fills and had similar catchment areas, forest types, and base geology."

Q. Okay. And why is that relevant? Why is that important

to the study?
A. Well, my interpretation is that they were trying to actually get the field data in which they eliminated confounding -- potential confounding factors.
Q. What confounding factors are they trying to eliminate?
A. Well, things like the area forested. So all of the stream reaches they sampled in were forested along the riparian corridor. They selected streams that had similar temperatures as well as similar habitat scores. So basically the kinds of things that the benchmark had tested for as confounding variables.
Q. And then it goes on to say, "These reference streams." Read the next sentence too.
A. "These reference streams were not pristine, as their catchments frequently had poorly maintained roads and culverts, utility right-of-ways, gas wells, or underground mining that did not discharge to the watershed."
Q. Okay. Why is that important that that's noted here?
A. Well, it shows that other forms of impacts to the watershed are not causing the kind of impairment you see below valley fills.
Q. Okay. And turn to page 291, if you would, please, the section labeled "Results."
A. Yes.
Q. Could you read the first sentence there?

A. "Between valley fill and reference groups, stream characteristics (catchment area, channel width, riffle substrate composition, discharge) were all similar."
Q. Continue.
A. "However, percent forest was significantly higher at reference sites."
Q. Why is it important that the percent forest was significantly higher at reference sites?
A. Well, those are unmined watersheds, and so those are the -- all the streams had forest along the riparian corridor, but the mined ones had lost their -- obviously much of the forest in the upper areas where the mining had occurred.
Q. Okay. And let me ask you, so this paper isn't based on DEP data either, is it?
A. No. This was -- this is what you would call a natural experiment when you actually select sites specifically to test a hypothesis.
Q. Okay. And then let's turn to the next page at table 1.
A. Yes.
Q. And we see -- well, what is table 1?
A. It's just a list of comparing the environmental variables that were measured at the reference --
Q. Uh-huh.
A. -- versus valley fill sites. And it shows the mean as well as the minimum and maximum values measured.

Q. And did it look at the embeddedness score?
A. Yes, it did. The mean for the reference was 17.3 and for the valley fill was 14.3.
Q. And why does it -- is it typical to use mean rather than median when you express data like this in a paper?
A. Usually when you have a table like this, it is.
Q. Okay. And temperature as well? Does it assess temperature effects?
A. I'm sure it does. Let me just --
Q. Towards the bottom of the chart.
A. Yes, it does. Temperature at the reference site, the mean was 13.8, and the mean at the valley fill site was 14.4. And they had almost identical maximum values at the mined and valley fill sites.
Q. Okay. Turn to page 294, the first column.
A. Yes.
Q. "We found that known sensitive taxa such as the mayflies" -- do you see that? -- "*Ephemerella* and" --
A. "We found that known sensitive taxa such as the mayflies *Ephemerella* and *Epeorus* and the caddisfly *Neophylax* were found at 100 percent of the reference sites but were absent from 12 of 15, or 80 percent, of the valley fill sites."
Q. What does that tell us?
A. Well, it tells you that most of those sites below valley fills, you know, had lost sensitive mayflies.

Q. Okay. And on page 296.
A. Yes.
Q. Second column, about halfway down. "VF age was not significantly correlated." Do you see that?
A. Not yet.
THE COURT: Which column?
MR. LOVETT: Second column, halfway down, page 296. "VF age."
THE WITNESS: 296. I was on the wrong page.
"VF age alone was not related to biological condition. VF age was not significantly correlated to any biological indicators or water chemistry."
BY MR. LOVETT:
Q. And then in the discussion at the very bottom of the page, "The idea of VF age." Do you see that?
A. Yes. "The idea of VF 'age' as a predictor of downstream recovery is plausible, but we found no relationship between valley fill age and any of the biological or chemical measures and thus it was impossible to predict recovery time with our dataset."
Q. And remind me, the older valley fills were -- had some forest cover, correct?
A. That's correct.
Q. Okay. On page 298 --
A. Yes.

Q. -- the first column, just a couple of inches down, the clause, not a sentence, beginning "our data indicated."

MR. MCLUSKY: Which column?

MR. LOVETT: First column, near the top.

THE WITNESS: This is page 298?

MR. LOVETT: 298. It's the sentence beginning "Despite federal and state mining" --

THE WITNESS: Yes. "Despite federal and state mining and water quality regulations intended to safeguard aquatic resources during and after mining, our data indicated that highly evaluated ionic concentrations may persist for over 30 years post-reclamation and that these chemical signatures result in damaged aquatic communities."

BY MR. LOVETT:

Q. Would you read the next sentence, please.

A. "Habitat can be a limiting factor, but by design, we removed significant habitat degradation factors by selecting sample reaches with relatively good habitat and intact riparian vegetation at reference and valley fill sites."

Q. Okay. So these were selected sites, again, not from the big DEP dataset.

A. That's correct.

Q. This is another way, then, of controlling for those variables that's different from the way the other publication did it by using the DEP dataset.

A. They took exactly the approach you would take in trying to control for variables that you weren't interested in measuring necessarily or that you weren't interested in testing.

Q. Okay. Let's turn to the next tab, please, which is 20.

You testified earlier I think that the level of impairment under the WVSCI is 68; is that right?

A. That's correct.

Q. Okay. Have you seen this letter before?

A. I have.

Q. Okay. Would you read the sentence beginning -- I guess it's the third sentence in the letter. It says, "For the reasons discussed."

A. "For the reasons discussed in the enclosures, EPA partially approves and partially disapproves West Virginia's Section 2012 303(d) list consistent with the requirements of the Clean Water Act Section 303(d) and 40" -- and I forget what C.F.R. stands for.

Q. Code of Federal Regulations.

A. Okay. Code of Federal Regulations.

Q. And then the next sentence.

A. "The basis of EPA's partial disapproval is West Virginia DEP's decision not to evaluate existing and readily available data regarding whether certain waters are achieving West Virginia's narrative water quality criteria as applied to the

aquatic life uses."

Q. Then would you turn to page 319, please, the last -- the second to the last page of that document.

A. Okay.

Q. And the sentence in the second -- or the first full paragraph on the page, the second to the last sentence, "West Virginia's use of the 'gray zone.'" Can you read that?

A. Uh-huh. "West Virginia's use of the 'gray zone' is statistically unsupported."

Q. Okay. That's enough. What's the gray zone, if you remember?

A. I think it was between 62 and 68, but I forget exactly.

Q. Would you turn to Exhibit -- or tab 21.

A. Okay.

Q. And is that another letter from EPA to Mr. Huffman at DEP?

A. Yes, it is.

Q. And would you turn to page 358.

A. Okay.

Q. And it says -- the last full paragraph on that page -- "WVDEP's use of a precision." Do you see that?

A. Yes.

Q. Could you read that sentence, please.

A. "West Virginia DEP's use of a precision estimate to establish the 'gray zone' is not statistically supportable

because the potential variability for which the gray zone is purported to account already is accounted for by variability in the reference sites."

Q. Okay. So you don't remember the numbers for the gray zone, but the gray zone, as you recall, is between 60 and 68 I think.

A. Yeah, in that region.

Q. And was DEP trying to use that gray zone to mark impairment rather than 68?

A. That's what these letters would imply.

Q. Do you know if DEP was doing that, or do you not know?

A. I don't know.

Q. Okay. But in any event, this letter says that it would be inappropriate, not statistically supportable, to use such a gray zone; is that right?

A. That's correct.

Q. And then let's turn to the tab 25.

A. Okay.

Q. And that should be another letter from EPA. And would you turn to page PE 383 of that, please.

A. I'm sorry. 383?

Q. Uh-huh.

A. Yes.

Q. And it says -- would you read the confounding factors -- strike that. We'll get to this. Let me strike that.

THE COURT: Would this be a good time to take a break?

MR. LOVETT: Yes, Your Honor.

THE COURT: All right. We'll take a ten-minute recess.

You may step down, but don't discuss your testimony.

(Recess from 10:34 a.m. to 10:52 a.m.)

THE COURT: All right. You may resume.

BY MR. LOVETT:

Q. Dr. Palmer, would you grab the joint exhibits again, 1 to 58.

May I approach, Your Honor?

THE COURT: Yes, you may.

BY MR. LOVETT:

Q. I think it's the one you had previously.

A. Are we going to go back to this?

Q. We'll use that again later. We're almost finished.

In the joint exhibits, would you turn to tab 58, which is the benchmark.

A. Okay.

Q. Okay. Now, based on the research that you just testified about and its own scientists, EPA published a benchmark in 2011, March of 2011; is that right?

A. That's correct.

Q. What is this document? What is the benchmark?

A. The benchmark is describing work they did to establish a relationship between extirpation of organisms and conductivity.

Q. And would you turn to page JE 396. Can you tell me who the authors of the benchmark were and, if you know any of them, if they're good scientists?

A. So you want me to identify the ones I know?

Q. Well, yes, if you know a scientist here that you think is particularly eminent in the field of stream ecology.

First of all, were there a lot of reviewers of the benchmark and contributors?

A. There were.

Q. Four principal authors, correct?

A. That's correct.

Q. And Cormier and Suter whose papers you testified about, right?

A. That's correct.

Q. And then there are other contributors as well, correct?

A. That's correct.

Q. One, two, three, four, five, six, seven, eight of those. Do you know any of those?

A. Yes, I do.

Q. Which -- who do you know here?

A. So Gerritsen I met at one point. Michael Griffith.

Q. Only if you know their work well. You don't have to just

have passing --

A. Greg Pond. I've read his work. I've never met him.

Q. Okay. And then there were one, two, three, four, five, six, seven, eight, nine reviewers, correct?

A. It looks to be the case.

Q. Was Dr. Menzie one of those?

A. Yes, he is listed as one of those.

Q. Okay. And also Pond and Passmore; is that right?

A. Yes.

Q. They are people who have published in this area, correct?

A. Correct.

Q. Okay. And then the Science Advisory Board Panel on Ecological Impacts of Mountaintop Mining and Valley Fills, there are one, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen -- fifteen of those reviewers, correct?

A. Correct.

Q. Okay. Almost all of them have Ph.D.s, don't they?

A. They do, and I know a number of them.

Q. Any of them particularly stand out to you?

A. Well, I know Beth Boyer at Penn State, who's an exceptional stream and river ecologist; Will Clements, who's an expert on toxicology in streams and rivers.

Q. Are these mostly faculty members at universities?

A. That's correct. He's at Colorado State. Beth Boyer is

at Penn State. Helderbrand is one of my colleagues at the University of Maryland. Lucinda Johnson I met from Minnesota. Alex Huryn.

There's, oh, yeah, a number of them. I've read Todd Petty's work. Sam Luoma used to head up CALFED in the State of California. I know him.

Q. Do you consider it an eminent list of reviewers and authors?

A. Yes.

Q. And then after this benchmark was written, was it reviewed by another body?

A. That's correct. I think that the -- these reviewers provided a report to the Scientific Advisory Board for EPA.

Q. Okay. Well, we'll get to that. Let's look at the benchmark briefly, though. We won't spend a lot of time on it. If you'd turn to page JE 464.

A. Okay.

Q. Do you see figure A-9 there?

A. Yes.

Q. And do you see the sentence above that figure?

A. I do.

Q. Would you read that, please.

A. "At the benchmark of 300 microsiemens, the corresponding WVSCI score is 64, which is impaired based on West Virginia's biocriteria. Using logistic regression, the probability of

impairment at 500 microcentimeters -- 500 microsiemens per centimeter is .72 and at 300 is .59."

Q. Okay. So this benchmark, then, determined that 300 microsiemens per centimeter generally has a corresponding WVSCI score of 64; is that right?

A. Correct.

Q. And that's an impaired score, based on your previous testimony, right?

A. Correct.

Q. Okay. And would you explain the logistic regression data there to us, what they mean?

A. Well, basically they're just referring to the relationship between conductivity and WVSCI score and the probability that you're going to, if you sample a bunch of streams, how many of those are going to be impaired at a certain level of conductivity.

Q. So 500 microsiemens per centimeter --

A. 72 percent will be impaired.

Q. And at 300, which is the benchmark --

A. About 59 percent typically impaired.

Q. Okay. So EPA sets that as the 300 microsiemens per centimeter as the point at which water quality standards will be violated based on the loss of 59 percent, right?

A. That's correct.

Q. Or 59 percent occurrence --

A. Yes.
Q. -- of loss. Okay. And does the figure A-9 support that?
A. It does.
Q. Okay. Let's now -- did EPA in the benchmark consider -- did it use the weight of evidence test or method?
A. It did. There were a number of steps involved in the causal analysis, and that was certainly one of the most important steps.
Q. And JE 472, this analysis -- or appendix B, it is an analysis of potential confounders. Do you see that?
A. I do.
Q. Could you tell us what it means to be a confounder.
A. Well, as I referred to before, you know, it basically means that there may be another variable that's leading to the relationship that you're interested in that is basically causing a false relationship or is at least confusing the relationship.
Q. Okay. So EPA determined that at 300 microsiemens per centimeter, there's going to be impairment in 59 percent of the cases, right?
A. That's correct, occurrences, yes.
Q. And then it looked after that to see if there were any other factors that might be causing that relationship.
A. That's correct.
Q. Okay. And that's what it did in appendix B, correct?

A. I think that's right. I forget what appendix number it was, but --

Q. Well, it's at JE 472.

A. Okay. Yes.

Q. Okay. And this is -- among the authors of this are Cormier and Suter, right?

A. Correct.

Q. And they're the people that we heard last trial came up with the CADDIS method, right?

A. Yes.

Q. And that's a weight of evidence test to determine when you can eliminate a confounding factor. Is that your understanding?

A. Yeah. It's related to causal analysis.

Q. Okay. So let's look at a couple of the factors, confounding factors, that were considered by the benchmark.

And first turn to JE 486, if you would, please.

A. Okay.

Q. And do you see B.4.4 there at the top of the page?

A. Yes.

Q. Okay. And that's deposited sediment, right?

A. That's correct.

Q. So the purpose of this exercise is to eliminate -- well, strike that.

The purpose of this is to determine whether embeddedness

or deposited sediment is a confounding factor. Is that true?
A. That's correct.
Q. Okay. And what data did, if you know, did EPA use to do this analysis?
A. They used data from the West Virginia DEP database.
Q. All right. And was that a large dataset?
A. It's extremely large; over many, many years.
Q. Okay. So did a statistical assessment to eliminate these confounding factors, right?
A. Well, yes, it used a variety of lines of evidence. That's correct.
Q. All right. And did it eliminate embeddedness as a confounding factor here?
A. Yes, it did.
Q. And how -- explain it just briefly. I think there will be more testimony by Dr. King, but I just want to briefly introduce how it did that.
A. Well, basically they just showed that, you know, when conductivity is low, even if embeddedness is high, you can have impairment, and vice versa. You know, at high conductivities, you know, even when there's no embeddedness, you can get impairment.
Q. So it found, for instance, in the table B-13, that there were 44 sites that it looked at, right?
A. Uh-huh.

Q. And the number of the sites that had conductivity of -- this is less than 200. So 44 out of -- well, what does that tell you?
A. Well, it tells me that 95 percent of the sites with embeddedness scores less than 7 --
Q. Uh-huh.
A. -- and conductivity less than 200 had mayflies; and that when you looked at even a higher embeddedness score, 99 percent of the sites they looked at had mayflies.
Q. So that tells us that embeddedness, at least at those scores, is not significantly impacting mayflies, right?
A. That's correct.
Q. And what does conductivity tell us?
A. Well, it tells you that, you know, when you don't have a conductivity problem, embeddedness is not really causing a confounding factor; but when embeddedness is lower and you get up to, you know, high levels of conductivity, you definitely get, you know, the impairment.
Q. Why do you think there were so fewer sites considered with conductivities greater than 1500?
A. Well, probably just there were fewer sites that had that, because those are mined sites.
Q. All right. And then let's turn to JE 492. Did EPA also consider temperature as a confounding factor?
A. Yes.

Q. And did it similarly eliminate conduct -- temperature as a confounding factor?

A. Yes, it did. It showed that so long as conductivity is low, even when temperature is greater than 22 degrees Centigrade, you found mayflies at 100 percent of the sites.

Q. Okay. And what about when conductivity was over 1500?

A. Well, the number of --

MR. MCLUSKY: Your Honor, at this point none of this is in any of her reports, any discussion about the confounding factors analysis. I don't really have an objection to going forward as long as we understand that they can't have cumulative testimony if Dr. King --

MR. LOVETT: Well, I'm just introducing the concept here that the benchmark contains a confounding factors analysis, and I really wasn't intending --

THE COURT: Well, you're going beyond that when you're asking her specific questions about the benchmark's analysis of these confounding factors.

MR. LOVETT: Okay. I'll stop, Your Honor. It is Dr. King who will mainly focus on this, and I don't want to have duplicative testimony.

THE COURT: Good.

BY MR. LOVETT:

Q. Now, the only -- the last question in this line is, these confounding factors assessments, as you testified, rely on the

DEP database, right?
A. That's correct.
Q. But you testified earlier particularly about a 2014 Pond paper that reached the same conclusions based not on the DEP database, correct?
A. They went to sites and sampled, yes.
Q. So by looking at -- the two methods confirm each other, right?
A. That's correct. They found the same result.
Q. Even though they used different sets of data to reach it.
A. Yes.
Q. Okay. Now, after the benchmark was developed and reviewed, it was sent to the Scientific Advisory Board; is that right?
A. That's EPA's procedure, yes.
Q. Okay. Will you turn back to Plaintiffs' Exhibits 1 to 26 and turn to -- do you have it there?
A. Is that the prior notebook we had?
Q. Yes, the one we just used.
THE COURT: Which exhibit?
MR. LOVETT: It is tab 25.
THE WITNESS: Okay.
BY MR. LOVETT:
Q. Do you see tab 25?
A. Yes.

Q. Okay. And is this the Scientific Advisory Board's review of the benchmark?
A. Yes, it is.
Q. Okay. How does that process work? Who's on the Scientific Advisory Board?
A. Well, it's a large number of people that are experts in a variety of fields that EPA has to deal with in their work.
Q. Very eminent scientists on there --
A. Oh, yes.
Q. -- right? And in this case, that Scientific Advisory Board appointed a committee to come up to review the benchmark; is that right?
A. That's right. They try and appoint a committee that is expertise, all of the people on the committee, to the topic at hand.
Q. Okay. And that committee is listed on page 374, right?
A. Right. I believe we went through that before. Oh, you mean the SAB?
Q. Yeah, this is the SAB, not the -- what we had before was the benchmark itself. Now we're looking at the SAB.
A. Right. So page 376, then?
Q. I was looking at 374.
A. Oh, I'm sorry. Okay. Yes. No, that's the panel on ecological impacts. That's not the SAB.
Q. I understand. Is this the group, though, that actually

reviewed, as you understand it --
A. Yes, it is.
Q. -- that actually reviewed the benchmark?
A. Correct.
Q. Okay. And, again, an eminent group of scientists in your view?
A. Oh, yes.
Q. Do you know some of them, some of their work?
A. Yes, I know many of them.
Q. Okay. And then once the SAB committee reviews the benchmark, does it pass it on to the full SAB?
A. That's my understanding. The report goes to the full SAB.
Q. And the SAB has -- well, let's look quickly. I would say on the review committee, there are, you know, are more than 12 reviewers, aren't there?
A. Yes.
Q. And most of those are professors at research institutions, correct?
A. Correct.
Q. Maybe all of them. And then on the Scientific Advisory Board itself, there are -- I'm just going to eyeball it and say 40 or so members, right?
A. That looks about right, yes.
Q. And those too reviewed the work of the -- they reviewed

the work of the committee.
A. That's correct.
Q. Okay. So the benchmark itself you testified earlier went through significant review and authorship, right, before it got to the SAB?
A. That's correct, and, of course, there was probably time for public comment. So many other scientists may have provided input.
Q. Okay. Now, the SAB determines -- let's look at page 383.
A. Yes.
Q. It concludes -- would you read the sentence in Causality between Extirpation and Conductivity that begins -- well, why don't you read that section.
A. "Building a strong case for causality between conductivity and loss of genera requires that two linkages be demonstrated: (1) a strong relationship between stream conductivity and the amount of mountaintop mining valley fill in the upstream catchment, and (2) a strong relationship between elevated stream conductivity and loss of benthic macroinvertebrate taxa. The EPA document presents a convincing case for both linkages."
Q. That's enough. So the Scientific Advisory Board agrees that EPA has presented a convincing case for those links, right?
A. Yes.

Q. And that goes with all the other research that you testified about earlier today.
A. That's correct.
Q. Is there any research that you're aware of that contradicts that?
A. I know of no research that contradicts it.
Q. Okay. It also says Confounding Factors. Would you read the first sentence there.
A. "The report has done a credible job in isolating the major, potential confounding factors and providing a basis for their assessment relative to the potential effect of conductivity."
Q. Read the next sentence.
A. "However, the report would be strengthened by further attention to potential confounding factors such as selenium and other trace metals, dissolved organic carbon, and hydrologic flows."
Q. Okay. It does not mention there that it's necessary to do any further analysis on temperature, does it?
A. It does not.
Q. Nor on embeddedness.
A. It does not.
Q. Nor any other habitat issue.
A. No.
Q. That's been resolved, hasn't it?

A. Yes.
Q. You've read the benchmark?
A. I have.
Q. Do you agree with it?
A. I do.
Q. Do you think it's good science?
A. I think it's excellent science.
Q. Have you read it carefully?
A. I have. I read it very carefully when it first came out, and I periodically look at different sections of it again.
Q. Let's talk about Stillhouse Branch specifically. Did you visit Stillhouse?
A. Yes, I did.
Q. And when did you visit it?
A. It was in January.
Q. Okay. Why did you visit it?
A. To observe the site so that I had a better understanding of what was going on there and to take some of my own measurements.
Q. Okay. Now, if you'd turn to Plaintiffs' 23, please, it should be a picture, an aerial --
A. Yes.
Q. -- depiction of the site. Now, this is Stillhouse where you visited, correct?
A. Yes, it is.

Q. Okay. This is at PE 363. Would you describe -- first of all, I think this is very similar, if not the same photo that Mr. Harvey put on the screen earlier.

A. Yes.

Q. Is that your understanding?

A. It looks like it.

Q. And I think he said you had testified many times before that an arrangement like this causes impairment. Did you hear him say that? You didn't testify -- he made that statement in his opening statement.

A. I heard him say that, and it surprised me. I have not testified to that.

Q. Okay. You've never testified to that, have you?

A. No, I have not.

Q. At least not in terms of habitat, right?

A. No, I haven't. I mean, no.

Q. Okay. Would you describe to us what is in this picture and what you saw when you were on the ground.

A. So we drove up to the site. From Nicholas Road you go around a curve and you cross a culvert. We drove further upstream and parked pretty much where that white line crosses the road and then walked to the stream at the end of the arrow there. After I sampled, I also walked all the way up to the top where the pond is and looked around.

Q. Okay. And where is the outfall?

A. The outfall is just above the point of that arrow where it says Open Channel 94.
Q. Okay. And was that a sampling point?
A. I sampled below the outfall, that's correct, but above the road crossing and culvert and so forth.
Q. Okay. Let me strike the question. Have there been samples, not that you took them, that you've reviewed that come from the outfall itself?
A. Oh, chemistry data, yes, correct.
Q. Okay. And those data would come from that point you just described where the outfall is.
A. That's right.
Q. And are there also data that you both took and reviewed that come from the stream segment just below the outfall?
A. That's correct.
Q. And you're saying that you gathered samples or took --
A. I took measurements as well as gathered some rock samples.
Q. And that was between the road and the outfall.
A. Correct.
Q. Okay. Why did you pick that site?
A. Well, I wanted to make sure I sampled above the road because we know that that can have impacts, and we were trying to look at the impact of the mine. And I wanted to sample below the outfall so that I was in the stream and not in part

of the constructed region associated with the mine and the outfall.

Q. Now, is there any contribution of water to Stillhouse Branch other than from Outfall 29?

A. No.

Q. Well, is that outfall -- is that called Outfall 29?

A. It is called 29.

Q. So is there any -- there's no other contribution to Stillhouse except from that outfall; is that right?

A. That's correct. My recollection is that the mining covered over 90 percent of the watershed draining to that --

Q. Are there any impacts --

A. -- stream.

Q. Are there any impacts upstream of where you sampled, except for the mine?

A. No.

Q. Are there some other impacts downstream?

A. Sure. There's the culvert piping, road crossing.

Q. Okay. But your sample was above all that, above the influence of that, right?

A. Correct.

Q. Now, did you walk down into Stillhouse and look at the stream?

A. Yes. I walked in the stream.

Q. Can you tell me your impressions of the -- your visual

impressions or other impressions of the stream?
A. Well, the stream, you know, was in pretty good shape. There was a little discoloration in the water immediately below the outfall. Otherwise, it was clear-looking. The bottom had heterogeneous substrates, but some of the substrates, a fair number, were covered with deposits. Precipitates of some sort was what I suspected. And there were some small areas associated with those precipitates where it appeared to be embedded so that if you kicked the bottom, it sort of stayed there. But the majority of the stream area wasn't embedded.
Q. Well, there aren't trees over the stream, are there?
A. In -- yeah, in most parts, not completely covered, not at all.
Q. Okay. So would you consider the streambed that you examined partly embedded and partly not embedded, or how would you describe it?
A. It was partially embedded, but only less -- certainly well less than 50 percent.
Q. And how large a segment did you look at when you were there?
A. I don't know. I didn't measure it. Twenty-five, thirty meters at least probably.
Q. All right. Would you turn to tab 45 in Joint, please. I'm wrong. I meant page -- I'm confused. Tab 13.

A. In the Joint?
Q. Yes, in the Joint.
A. Okay.
Q. Okay. Do you recognize that?
A. I do.
Q. It says table 1, summary of metrics. Is that it?
A. Yes.
Q. Okay. What is that?
A. Well, it's the WVSCI scores and the GLIMPSS scores from the samples that were collected by Chris Swan in --
Q. Who is Chris Swan?
A. Dr. Chris Swan is a professor, an ecologist, stream ecologist, who his expertise is in stream invertebrates, their dynamics, communities.
Q. He was engaged by plaintiffs to do this analysis, right?
A. That's correct.
Q. Okay. And what did Dr. Swan find on September 30th?
A. Well, he found that, using both the WVSCI criteria and the GLIMPSS criteria, the stream was impaired significantly.
Q. Okay. Do you know what the GLIMPSS number for impairment is?
A. I think it's 53 for impairment, and this was 27.7.
MR. MCLUSKY: Object, Your Honor. West Virginia doesn't use the GLIMPSS and as far as I know doesn't have an

impairment threshold.

THE COURT: What's the relevance of the GLIMPSS?

MR. LOVETT: Just to help the Court understand how bad the aquatic life is. There may not be a legal standard in West Virginia, but it certainly informs the Court about the state of the stream itself.

THE COURT: All right. Overruled.

BY MR. LOVETT:

Q. The WVSCI score here is 58, right?

A. That's correct.

Q. 68 is the level of impairment, correct?

A. Correct.

Q. Okay. And Dr. Swan visited the site himself to take the samples that that's based on, correct?

A. Yes. He sampled in the same area that I did.

Q. Okay. Would you turn to the next tab.

A. Yes.

Q. And is this Dr. Swan's data too?

A. It is the -- the taxonomic identifications were done by Pennington & Associates. He sent them the samples after he had picked the bugs out of them is my understanding.

Q. Okay. And this is a -- these are family data, family-level data?

A. That's correct.

Q. And --

A. Order and family.
Q. And WVSCI is a family-based metric, correct?
A. Yes.
Q. Okay. What does this -- what do these data tell you?
A. Well, it tells me that, first of all, there's no Ephemeroptera, there's no mayflies, and that within the sensitive group where we look at typically the mayflies, stoneflies, and caddisflies, you have a fair number of caddisflies, 78 and 31, in two different families. And those are relatively tolerant. They have genera in them that are tolerant. And there was only one family of stoneflies found.
Q. What does it means that there was only one family of stoneflies? How does that --
A. Well, they're just very sensitive, and so most of those presumably had been extirpated from the site.
Q. So what you see are taxa that are not sensitive to high conductivity, and what you see missing are those that are, correct?
A. That's correct.
Q. Could that be caused in this case at this site by the embeddedness of the stream?
A. No. You wouldn't have lost all of your mayflies when the majority of the stream isn't embedded.
Q. And have you seen the temperature data for this stream?
A. Yes.

Q. And could those losses be caused by the high temperatures?

MR. MCLUSKY: Let me object, Your Honor. There's no statement to that effect in her report, either report.

MR. LOVETT: There is a statement that -- where have you seen the temperature data for Stillhouse?

THE WITNESS: The temperature data for Stillhouse I saw in Menzie's report that I wrote a report in response to and discussed temperature.

THE COURT: All right. Overrule the objection.

BY MR. LOVETT:

Q. And what were the high temperatures in that report, if you remember?

A. Well, I think, as I recall, he had the Stillhouse temperature, a maximum temperature, I think 23 or 24 degrees Centigrade.

Q. And at a temperature of 24 degrees, would you expect to see extirpation of mayflies?

A. No, not without any other problem in the stream.

Q. And how do you know that?

A. Well, it's largely just based on the fact that I've been working in streams with insects and mayflies for a long time, and we even find mayflies in some of our streams that are as high as 30 degrees C.

Q. Let's turn to the next page. And this is a species-level

depiction of the same gathering of data, right, of insects?
A. Yes.
Q. Are there any mayflies there?
A. No mayflies.
Q. Do you see the same pattern there, the tolerant -- the species that are tolerant to high conductivity there but not those that are sensitive?
A. Yeah. And it just confirms what I said, that there are genera within those families that are very sensitive. So *Hydropsyche*, there were 51 of those. Those are the kind of caddisflies I find in very degraded urban streams too. So they're very tolerant.
Q. Okay.
A. And also the simulids are tolerant.
Q. Okay. Could you turn to tab number 4, please.
A. Okay.
Q. Now, have you seen this before?
A. Yes, I have.
Q. Are these sampling data taken from Evan Hansen at Downstream Strategies?
A. Yes. So I saw Mr. Hansen's report, and this table was in it.
Q. Is he also engaged by plaintiffs to gather this information, if you know?
A. Yes.

Q. Okay. And on the -- he sampled, as I see it, at Outfall 029, which would be the outfall at Stillhouse that you described on page 263, right?
A. Yes.
Q. And he also sampled, it looks like, in the stream below that.
A. Yes.
Q. Do you know where he sampled in the stream below that?
A. I only know it was below the outfall and I think in the general same area Chris Swan sampled.
Q. Okay. And do you see the conductivity levels that he found there?
A. I do.
Q. How many microsiemens per centimeter did he find?
A. In the Outfall, 2826; and in the stream, 2825.
Q. Okay. What about the total suspended solids at the very bottom, 3.0? Is that high?
A. Not particularly high.
Q. And he had one non-detect I see, right?
A. Yes, in the stream.
Q. And did you sample -- did you take a conductivity sample when you were there?
A. I did.
Q. What number did you hit?
A. I think it was almost 1800. I'd have to look back at the

data.
Q. Let's look at 26. I think this describes Mr. Hansen's sampling sites, the question I asked you earlier.
A. Wait. Tab 26?
Q. No. I'm sorry. Page 26, tab 5, the next tab. Sorry. I may have confused you.
A. Tab 5?
Q. Yes, the page right after the one we were discussing.
A. Yes.
Q. Can you see where his sampling sites are now?
A. I do see those. So it looks like he had three of them in the spillway, bottom of the spillway, and then downstream.
Q. Very similar to your sampling sites, aren't they?
A. The downstream, yes.
Q. Where did you take your conductivity measurement, approximately, based on JE 26 here?
A. Approximately the same place he did, his downstream site.
Q. Downstream from 029?
A. Correct.
Q. Would you turn to tab 9.
A. Yes.
Q. It's a picture taken by Mr. Hansen. Did you see that site? I'm sorry. It was taken by Miss Betcher, who works for Mr. Hansen.
A. Yes. I was at the very same site.

Q. What does that picture tell you about the site?
A. Well, it looks as if he saw the same sort of cloudy water immediately below the spill, and then -- spillway, and then it clears up and you see the bottom of the stream.
Q. Okay. And what about in the next picture, tab 10?
A. It shows, you know, nice flow. I can't tell if there's trees overhead. They're not right on the edge of the stream. But good flow. I see large rocks.
Q. Okay. Get the other joint exhibit notebook, which is joint exhibits starting with 58.
I draw your attention to tab 59 there.
A. Yes.
Q. Is that the West Virginia 303(d) list, if you know?
A. It's their assessment report to EPA in 2012, yes.
Q. 2012. Would you turn to page J 693.
A. Yes.
Q. And do you see Stillhouse Branch listed in that report about halfway down the page?
A. Yes, I do. There's two Stillhouse Branch, I guess, sampling sites.
Q. And do you see that it is listed as CNA, impaired for biological purposes?
A. Yes, that's what it says.
Q. And the impaired size of the -- is 1.9 stream miles or the entire length?

A. That's correct.
Q. Would you turn to Joint Exhibit 43. I'm sorry to go from notebook to notebook. We should've put the notebook together in order for the testimony. And turn to tab 43, please.
A. Yes.
Q. This is a stipulation of the parties about historical data --
A. Yes --
Q. -- correct?
A. -- it appears to be.
Q. Have you seen these before?
A. Yes, I have.
Q. Can you -- so on the JE 126, do you see pre-mining conductivity numbers?
A. Yes, I do.
Q. And those numbers are fairly low, aren't they?
A. Yes. The highest one is 104. The lowest one is 47.
Q. Well below the benchmark, correct?
A. Well below, yeah.
Q. And then on the next page, though, we have historical numbers after the beginning of mining at JE 127. Do you see that?
A. I do.
Q. And those conductivity numbers, on the other hand, are significantly elevated, well over two and three thousand for

the most part, right?
A. That's well over 2000, almost 3000, yes.
Q. And the sulfate numbers likewise are significantly elevated from background, aren't they?
A. I'm sorry. I was looking at sulfate. Those are really high numbers for sulfate. Conductivity, yes, goes well over 3000, and sulfate goes very, very high.
Q. And those are related to each other, as you've testified, right?
A. In this region, yes.
Q. Sulfates is a marker for --
A. It's a marker for coal in this region.
Q. So that shows that there are high sulfates being discharged from this mine, right?
A. Correct.
Q. And it shows that those sulfates and other constituent ions have raised conductivity to levels many times the benchmark, correct?
A. That's correct.
Q. Now, those measures were measured by DEP; is that right? That's what it says in 11?
A. That's correct.
Q. Okay. Then at later dates on page JE 129 --
A. Yes.
Q. -- from the outlet itself, again we only have

conductivity numbers here and not sulfates, but still in most instances more than 10 times the benchmark, correct?

A. That's correct.

Q. Are those extremely high conductivity numbers in your experience?

A. Yeah. Other than in the mining area, I've never noted them that high before in any other streams.

Q. Now, comparing those conductivity numbers -- those conductivity and sulfate levels with what you saw with embeddedness and what you understand the temperature to be at this site, is there any question about what's causing the impairment?

A. Absolutely no question. It's the elevated conductivity.

Q. And the sulfates?

A. And sulfates. Well, that's part of it, yes.

Q. Would you explain a little more about how you reached that conclusion, why you eliminated the other two and picked this one?

A. Well, there's a variety of lines of evidence, but at this particular site --

Q. At this site.

A. Right. Only a small fraction of the bed appeared to have embedded spots in it. The temperature was well within a range. The oxygen levels were fine. Habitat heterogeneity was high. Flow status was excellent.

Q. Okay. And those historical data are consistent with the data that both you and Mr. Hansen gathered, correct?
A. That's correct. Elevated conductivity we all found.
Q. Would you turn to Joint Exhibit tab 18, please.
A. Yes.
Q. Well, let's skip 18. Well, let me ask you, is that the site that -- is that the Stillhouse site, as far as you can tell?
A. Yes, it is.
Q. And I think you've testified -- let's turn to the next tab, 19.
A. Those are the data that I collected when I went out and sampled, showing elevated conductivity, a temperature of 7.4 degrees and 100 percent oxygen saturation.
Q. What does that mean? Why is the oxygen saturation there, and why did you put that there?
A. It's one of the things you always want to rule out, that you don't -- you aren't in a region where you've got anoxia and the organisms can't survive. And obviously that's not a problem here.
Q. And on tab 20, let me -- these are tables from your expert report, right?
A. Yes.
Q. Okay. On tab 20, you have pre-mining data in Stillhouse. Do you know where those came from?

A. Those came from the SMCRA permit, I believe, section.
Q. Okay. All, again, well below the benchmark, right?
A. Yes.
Q. And the next tab, did you plot -- this is tab 21. Did you plot those --
A. Yes, I plotted the data.
Q. Explain to me -- well, explain to the Court -- let's start with the top one. What does figure 2a show?
A. Well, basically provides just a nice pictorial of what we've just described; that is, pre-mining back in the early '90s. Conductivity was well below levels of concern. And by, you know, 2004, the numbers were really high.

Here, numbers -- many of these collected by the coal mining company itself or their consultants -- were at levels reaching sometimes almost exceeding 4000 microsiemens. Sulfate was much higher than I had ever seen, up to almost 3000 post-mining when, as I said earlier, DEP had identified 50 as the threshold for indication of mining impacts.

Q. Okay. And on tab 22 --
A. Yes.
Q. -- these are data from Outfall 29, right?
A. This is the outfall that is feeding into the stream, the outfall directly from the valley fill and the pond.
Q. And these are all the data points that you had?
A. These are data points that come from monitoring reports

that the coal company submitted to DEP, yes.
Q. Again, this is a pictorial representation of the kind of thing --
A. That's right.
Q. -- you've talked about before. Turn to tab 23.
A. Yes.
Q. Is this something you prepared too?
A. It is. I collected rocks from the bottom of the stream, and I had taken with me reverse osmosis water, which is very low conductivity. I think it started out with conductivity about 15 microsiemens. I had replicate containers without --
Q. Let me slow you down. You mean the water you took had 15 microsiemens?
A. That's correct.
Q. Okay. And then you took a rock from the stream?
A. I took multiple rocks from the stream, and in each one of the containers I put a single rock, and I had the conductivity probe in the container, and I watched how conductivity, along with the consultants that had come from -- I believe the defendants had sent them. We watched the conductivity increase over time in the water that had previously had low conductivity until we put the rock in.
Q. How high did the conductivity go in the water?
A. Well, I stopped, you know, after almost 15 minutes, and the conductivity went up to 50 microsiemens per second.

Q. What did it start at again?
A. 17.
Q. Okay. And why did you do that?
A. Well, because in my prior testimony in a previous trial, there seemed to be concerns raised that potentially material on the rocks was silt, and I had been certain it was deposits of precipitates. And so I thought, well, if it's deposits and the streams below mine sites are often super saturated in the minerals that caused the deposits, then if you put it in water that's clearly undersaturated, some of it will go into solution.
Q. And that, in fact, happened, right?
A. That, in fact, happened.
Q. What did that tell you about the sediment on the bed of the stream?
A. Well, it wasn't sediment. It was precipitates. But I had the -- I chose to have it analyzed chemically by a geochemist also.
Q. Okay. And that geochemist may testify here, right?
A. Yes, I believe she's going to.
Q. Okay. So based on that, do you conclude that the precipitate on the bottom of the stream is caused by high conductivity and associated ions?
A. That's correct.
Q. So if there is an embeddedness problem there, it would be

caused by the conductivity and associated ions.
A. It would be caused by the heavy precipitates on some of the rocks, yes.
Q. But, again, you don't believe that embeddedness is the cause of the impairment here, do you?
A. No. There was not enough embeddedness throughout the stream to have caused the level of impairment we see.
MR. LOVETT: One minute, Your Honor. I'm almost finished.
THE COURT: Okay.
BY MR. LOVETT:
Q. Would you turn to the Joint Exhibits 1 to 58 notebook.
A. 58?
Q. It's the notebook that says 1 to 58. I need you to turn to tab 12 in that notebook.
A. Yes.
Q. And that's -- this is the report by Christopher Swan, who you testified about earlier, right?
A. Correct.
Q. Would you turn to page JE 47.
A. Yes.
Q. And he did a rapid bioassessment protocol also on his visit, didn't he?
A. Yes, he did.
Q. Can you explain to me what he found with the rapid

bioassessment protocol?
A. Well, he looked -- you know, did the entire RBP, but he really focused on the sub-scores that had been identified when the rapid assessment method was developed.
Q. May I just interrupt you for a second? You can look at his lab sheets if you'll turn to tab 26 in the other notebook, in the plaintiffs' notebook.
A. Okay.
Q. Okay. So can you just, you know, explain to the Court what Dr. Swan did when he took the rapid bioassessment protocol and what he found?
A. Well, he followed the standard procedures of the EPA rapid bioassessment that was developed by Michael Barbour and others sometime ago and, you know, walked the section of the stream and then scored each of the categories that make up the RBP. And in the report, he focuses on five of those.
Q. Do you know which section of the stream he walked?
A. The same one I did.
Q. Okay. And let's look at each of these in turn. At PE 418 in Plaintiffs', there are --
A. Yes.
Q. -- one, two, three -- there are four pages there.
A. Yes.
Q. Okay. So what did -- you say he looked at how many factors?

A. Well, just in his report, he emphasized five factors, the ones that are typically used to try and assess impairment based on habitat.

Q. Okay. So the data sheets are what he found particularly. Let's look at embeddedness, for instance, at PE 420.

A. Yes.

Q. And there he scored embeddedness as a 14, right?

A. Yes. That would be a suboptimal, which is just below optimal.

Q. Right. So I think that's like a grade of a B. Is that fair?

A. I guess pretty much.

Q. Okay. And, you know, I know you didn't perform it on the same day, but would you agree based on your observation -- strike that.

Have you performed a rapid bioassessment protocol yourself?

A. I have, many times, but I did not on Stillhouse.

Q. All right. Does that seem reasonable to you, the 14, based on your observation there?

A. Yes. You know, the issue here, though, is oftentimes embeddedness is discussed not in terms of chemical precipitates pulling -- you know, locking things together, just silt and sediments and so forth. But, yeah, that would be consistent.

Q. Okay. And the same is true of sediment deposition, suboptimal, correct?
A. Yes. And that would be in some of the locations on the stream, correct.
Q. Okay. Any other habitat parameters that strike you as particularly important for the assessment at issue here?
A. Well, in terms of impairment for biologically, no. I mean bank stability was poor. So there was some eroded banks. And as I said before, the entire thing was not fully forested. So the riparian score at least on one of the banks, the right bank, was marginal; whereas on the left bank, it was optimal. So -- but none of those would be a problem in terms of causing the impairment. They're not anything at that level.
Q. And did he come up with a final tally?
A. I think his tally was 130, if I recall. Yes, it was. It says right here.
Q. And that is suboptimal, right?
A. Correct.
Q. Would you expect to see a suboptimal rapid bioassessment protocol result in a situation in which there are no mayflies?
A. No, not habitat; no.
Q. So do you believe that the habitat is not -- that this rapid bioassessment protocol helps show that the habitat is not responsible for the impairment at Stillhouse?
A. That's correct.

Q. Do you hold the opinions -- all the opinions you've expressed here today to a reasonable degree of scientific certainty?

A. More than a reasonable degree; a highly certain degree.

MR. LOVETT: Okay. That's all I have except to move the admission of the exhibits.

THE COURT: All right. Do you want to do that at this time?

MR. LOVETT: It might be better, Your Honor, while Mr. McLusky -- or at lunch, I can go through and make sure that I catch every one that --

THE COURT: All right. We'll take a lunch break until 1:00.

You can start cross then.

Be ready to deal with your exhibits when we start back.

MR. LOVETT: Thank you, Your Honor.

THE COURT: You may step down. Don't discuss your testimony. We stand in recess until one.

(Lunch recess from 11:53 a.m. to 1:10 p.m.)

AFTERNOON SESSION

THE COURT: All right. Ready to proceed?

MR. MCLUSKY: We are, Your Honor.

THE COURT: All right. Cross-examination of Dr. Palmer. Will you take the stand.

Have you resolved what you want to do about the exhibits?

MR. LOVETT: I'm afraid that it's not resolved, Your Honor. I mean I don't think we have a big dispute, but I can move the admission of exhibits, and I think Mr. McLusky will probably object to some of them.

THE COURT: Well, at some point we need to do that. Are you satisfied to do it now or --

MR. MCLUSKY: We can do it now or we can do it at the end of Dr. Palmer's --

THE COURT: I don't mind waiting until the end of her testimony.

All right. You may proceed with your cross.

CROSS EXAMINATION

BY MR. MCLUSKY:

Q. Dr. Palmer, do you have the notebooks up there?

A. Yes, I do.

Q. Could you turn to Plaintiffs' 15, which I believe is the Pond 2008 paper. If it's not, please let me know.

A. Okay.

Q. Mr. Lovett had you look at the abstract, which is on page PE 202, I believe. Do you recall reading parts of that?

A. I do.

Q. Can you point to me any statement in this abstract that conductivity or sulfate cause any particular effect in any stream anywhere?

A. They don't specifically mention conductivity and

associate that with impairment in the abstract; you're correct.

Q. You were an advisor or at least reviewed this paper for Mr. Pond, didn't you, back in 2008?

A. Yes. I provided an informal review before he submitted it to the journal.

Q. Presumably if he believed that conductivity was causing any of these things, he would have said so in this abstract because it would have been pretty important, right?

A. I don't know if he -- I mean he was primarily looking at the amount of mining. So I can't answer what he would have done.

Q. Well, in fact, he used conductivity simply as a surrogate for mining, did he not?

A. I believe so.

Q. Dr. Palmer, would you turn to page PE 211, which is page 726 of the Pond 2008 article, Plaintiffs' 15.

A. Okay. I'm there.

Q. Do you see that table 4?

A. Yes, I do.

Q. Do you see that's a table of correlation coefficients for various potential or potential insults to the environment?

A. Yes, I do.

Q. What is the correlation coefficient between RBP habitat score and the WVSCI scores on table 4?

A. It's .74.
Q. That's considered high, is it not?
A. It is relatively high, yes.
Q. And for the embeddedness score, it's .57; is that correct?
A. That's correct.
Q. And that's also relatively high, isn't it?
A. Relatively so, yes.
Q. The .74 is by benchmark standards considered moderately or strongly correlated, is it not?
A. Yes.
Q. If you'd turn to page PE 215 of the same article, which is page 730 of the article.
A. Okay.
Q. Okay. In the second column --
A. Yes.
Q. -- about midway through that first full paragraph, you'll see a sentence that starts with "Howard."
A. Yes.
Q. Could you read that sentence for me, please?
A. Sure. "Howard et al. (2001) and Pond (2004) reported that habitat indicators (chiefly sedimentation and embeddedness) were strongly correlated with MMIs and particular metrics in Kentucky headwater streams."
Q. And an MMI is a multi-metric --

A. Indices.
Q. -- indices?
A. Uh-huh.
Q. And that's things like the WVSCI; is that correct?
A. That's correct.
Q. And then if you'd turn to the next page, it's PE 216.
A. Yes.
Q. And he has a series of -- he has six paragraphs here. I'm not sure what they are. But look at paragraph 6, if you would.
A. Okay.
Q. And it talks about both ionic stress and landscape disturbances are correlated with downstream impairment in empirical studies.
Does it not say that?
A. Yes, it does.
Q. Pardon my fumbling. We have a couple of different numbering systems here.
Would you turn to page PE 211 of the same article.
A. Okay.
Q. And in the second column, towards the end -- it may even be the last sentence --
A. Yes.
Q. -- it begins with the word "Our." Do you see the words "Our bioassessment"?

A. I do.
Q. Could you read that for me?
A. "Our bioassessment indicators were not strongly correlated with dissolved or total metals concentrations in the water column, but these results do not rule out possible exposure to metals via dietary uptake or microhabitat smothering by metal hydroxide precipitation."
Q. Thank you. Turn to Plaintiffs' Exhibit 16, which is Pond 2010, if you would, please.
A. Okay.
Q. Now, this page 223 also has an abstract, does it not?
A. It does.
Q. And is it fair to say that nowhere in this abstract is there any statement that either conductivity or sulfate have or can cause any particular effect to benthic macro-invertebrates?
A. It does not. It refers to mining disturbance and residential development.
Q. And if I turn again in the same article to PE 233 in the second column -- let me know when you're there.
A. Okay.
Q. This actually has line numbers I think on the right-hand column.
A. Yes.
Q. If you look at line 593 --

A. Okay.
Q. -- does this not also say that although Pond et al. 2008 did not find strong correlations of mayfly abundance and richness with mining-related trace metals in the water column, except selenium, they state that possible exposure to metals through dietary uptake or potential microhabitat smothering by metal hydroxide precipitate or iron bacteria blooms could not be ruled out?
A. Yes, it does say that.
Q. Then flip ahead, if you would, to Plaintiffs' 17, which is Pond 2011.
A. Okay.
MR. LOVETT: What page, Bob?
MR. MCLUSKY: It's tab -- it's Plaintiffs' 17, page PE 240, which is the first page of -- I call this Pond 2011. I think that's how we referred to it.
BY MR. MCLUSKY:
Q. Is it fair to say again, Dr. Palmer, that this abstract, which I think you may have read from, likewise does not state that conductivity or sulfate can or have caused any particular impacts to any stream biota anywhere?
A. It says there's a high correlation with conductivity.
Q. But the question I asked you was, does it state --
A. It doesn't say --
Q. -- a causal connection.

A. No, it does not say cause.
Q. It also says, does it not, in the second column of the abstract, that the O/E index was highly correlated with individual habitat?
A. It does.
Q. And "O/E" means?
A. The observed versus expected.
Q. That's a ratio of number of bugs you expect -- what you find and what you would expect to find?
A. Well, or the composition, yes.
Q. So at least in the abstract, they find a high correlation between the index they chose to use here and individual habitat, right?
A. They did.
Q. Plaintiffs' Exhibit 19. If we turn to that next, which I think starts at PE 287. And this is Pond 2014.
A. Okay.
Q. I'll ask you the same question. Isn't it true that there's nothing in this abstract that you read from that says that conductivity or sulfate have or can cause any particular effects to macroinvertebrates anywhere?
A. That's correct, it does not say that.
Q. All right. Would you turn, then, to page 292 of the same exhibit.
A. Okay.

Q. And this is a table 1. Do you see this?
A. I do.
Q. And you testified earlier that Pond had looked at temperature, is that correct, in this article?
A. I don't remember if it was this one or another one.
Q. If you look --
A. Yes. It's there, yes.
Q. Yes, there's temperature listed here. But if you look at the -- over in the left, there's a legend, whatever it is, says concentrations are in milligrams per liter. Do you see that?
A. Yes, I do.
Q. Is it fair to say that the data on this table appear to have all been collected in April?
A. That's correct, which is when I think they sampled.
Q. Right. So the temperature data here would be from April, then; is that correct?
A. Yes.
Q. Now, as I understand Plaintiffs' Exhibit 19, the Pond article, they did not use a WVSCI test here. They used some type of GLIMPSS. Is that correct?
A. That's correct.
MR. MCLUSKY: Pardon me just a minute.
Pardon me a moment, Your Honor. The pages in the original article are not numbered. They were numbered only in

the exhibit, which I didn't have when I prepared it.

THE COURT: All right. Take your time.

BY MR. MCLUSKY:

Q. Dr. Palmer, if you'd turn to page 295.

A. Okay.

Q. Second column, first full paragraph. Does that not say, "As expected, percent forest had moderate to strong negative correlations with biological indicators"?

A. That's correct.

Q. So when they compared -- and it's fair to say with review of this report, you would find that there's a higher percent forest at the unmined sites than there was at the mined sites; isn't that correct?

A. Right. The mining removes trees, yes.

Q. So there was a higher degree of correlation between the percent of forest cover and impacts to macroinvertebrates here.

A. That's correct.

Q. Okay. What they did, they found little correlation in percent of valley fill area within the valley fill community in this report, but they -- but as between the unmined and the mined sites, percent forest cover did matter, did it not?

A. I don't -- the first part of what you said, I don't know. I'd have to go back and read the paper. But the second part, they did find a relationship between amount of forest in the

watershed and the biological indicators.
Q. I think we confirmed they found a moderate to strong correlation, didn't they?
A. Yes.
Q. Now, let's go back to some basic credentials here. Is it fair to say that you don't consider yourself an epidemiologist at all?
A. That's fair.
Q. In fact, you really haven't taken any classes in that discipline.
A. I have not had a class in epidemiology.
Q. And while you may have used statistics, you don't hold yourself out as a statistician. Is that a fair statement?
A. That's correct. I'm not a statistician.
Q. And I think you told us before you haven't independently reviewed any of the statistics used by either the benchmark or the Suter and Cormier papers, have you?
A. In the deposition I said that I had not replicated their analysis and run it myself.
Q. Okay.
A. That's correct.
Q. Fair enough. I believe you told us before you're not a chemist.
A. I'm not a chemist, no.
Q. Okay.

A. I do a lot of biochemistry, but I'm not a chemist.
Q. You've also testified before you're not a toxicologist.
A. That's correct.
Q. And I think you said you're not a biogeochemist like Dr. Bernhardt when she testified here.
A. It's not my sole, primary area.
Q. In fact, I think when I asked you back in 2012 about the differences between your expertise and Dr. Bernhardt's, you said, "I'm a restoration expert. My background and Ph.D. is actually in oceanography. I work at the interface of fluid mechanics and dispersal of small marine organisms."
Is that a fair characterization?
A. The characterization reflects what I did for my Ph.D., but it's not a characterization of my career.
Q. And I think you then told me that it's the biogeochemist, which was Dr. Bernhardt, I believe, who spends more time looking at the mechanics of which mine effluent might affect benthic macroinvertebrates.
A. She looks at the geochemistry much more than I do, that's correct.
Q. In fact, your earlier testimony before this Court was primarily about the potential of mitigation projects to restore function, wasn't it?
A. You can't look at restoration without looking at biogeochemistry, and you can't look at function without

biogeochemistry.

Q. Have you done any original lab work on the effects of any mine drainage on aquatic insects at all?

A. No laboratory work, no.

Q. Have you done any field work?

A. No, except a small amount of sampling I've done for the trials. That's correct.

Q. All right. There was testimony earlier about the SAB review of the EPA benchmark; is that correct?

A. That's correct.

Q. And I think that's Plaintiffs' Exhibit 25, if I'm not mistaken.

Now, I think Mr. Lovett established earlier that the benchmark itself is dated March of 2011; is that correct?

A. I don't remember the dates exactly. If he stated that, then I agree with you.

Q. I'll skip it. At any rate, Plaintiffs' Exhibit 25 is the SAB report, letter and report to EPA; is that correct?

A. That's correct.

Q. And it's dated March 25th of 2011, right?

A. It is.

Q. Okay. Doesn't this report -- and I'll direct you to page -- do you guys have page numbers on here? Can you get me Dr. Palmer's --

(Mr. McLusky and Mr. Lovett conferred privately off the

record.)

THE WITNESS: Okay.

MR. MCLUSKY: Mr. Tyree, could you turn to tab 18, which should be the SAB report of 3/25/11.

THE WITNESS: I'm sorry. What page?

MR. MCLUSKY: Page 20 of the report itself.

THE WITNESS: Okay.

MR. LOVETT: Your Honor, Bob, we don't have these pages. We need to be able to follow.

THE COURT: Can you identify where this is, Mr. McLusky, in the report?

MR. MCLUSKY: My problem, Your Honor, is that the report had internal page numbers. Those page numbers have not been reproduced in the plaintiffs' exhibit. They have a separate paging system. So I have a hard time correlating the two. I don't necessarily intend to introduce this document.

THE COURT: I understand. Just some guidance on where to find this page within the document.

MR. LOVETT: I believe it's page 400, PE 400.

THE COURT: All right.

MR. MCLUSKY: Mr. Tyree, would you show the language so I can read it. Blow it up a little bit.

BY MR. MCLUSKY:

Q. Is it fair to say, Dr. Palmer, that on page 20 of the report, or page PE 400 of the Plaintiff's Exhibit 25, the SAB

says that conductivity itself is not a pollutant but is a surrogate measure for the major constituent ions in the mixture?

A. Correct.

Q. That's an accurate statement, isn't it?

A. That's correct.

Q. And then two sentences later, the SAB says, "Furthermore, if there are unaccounted factors -- if there are unaccounted for factors that may be confounding the causal relationship between stress from specific ions and taxa loss (e.g., dietary selenium exposure or slight reductions in habitat quality), conductivity may still be interpreted as a signal for the presence of the combination of factors resulting from the presence of upstream valley fill."

Is that correct?

A. It does say that, yes.

Q. And if I turn back to what should be PE page 371 or -- which is also -- I think you can leave that notebook. Just turn back to the tab 18 in your notebook.

A. Okay.

Q. Page 2.

A. Okay.

Q. Mr. Tyree has it up on the board, I believe.

Didn't the SAB panel also say that the scientific credibility of the benchmark would be strengthened by analysis

relating the constituent ions to observed biological community changes?

A. Yes, it says that.

Q. Now, if we could jump to the final -- actually, the benchmark, Joint Exhibit 58.

A. Okay.

Q. And I need to find -- well, am I wrong?

(Mr. McLusky, Mr. Tyree, and Mr. Becher conferred privately off the record.)

BY MR. MCLUSKY:

Q. If I turn to page 26 of the report itself, which I believe is JE 408 --

A. All right. I'm there.

Q. Mr. Tyree, could you show it up on the board too?

Is it fair to say that EPA in the final benchmark under the heading Treatment of Mixtures says, "However, conductivity per se is not the cause of toxic effects"?

A. That's correct, it says that.

Q. Okay. And then if you turn to page A-40 of the report -- and I'm going to struggle to find the PE page number here.

A. I've got it.

Q. I'm looking for a PE page number.

THE COURT: Doctor, do you think you found it in the exhibit, JE exhibit?

THE WITNESS: Yes.

THE COURT: Which page?

THE WITNESS: JE 468.

MR. MCLUSKY: Oh, great. Thank you.

BY MR. MCLUSKY:

Q. Is it fair to say that in the last paragraph, under the Conclusion section there, that it says, "This causal assessment does not attempt to identify the constituents of the mixture that account for the effects"?

A. It does say that.

Q. So this report says in one place that conductivity per se is not the cause and then later on says it doesn't attempt to identify what the particular constituents are that do account for the effect. Fair statement?

A. That's a fair statement.

Q. Didn't Suter and Cormier say the same thing in some of their papers?

A. I don't know. I mean the focus of this and their papers is on the ionic strength of the water which conductivity directly measures as a cause.

Q. Let's go to Plaintiffs' Exhibit 3, if we could.

Are you there?

A. Not quite. Okay. I'm there.

Q. If you'd turn to page 269, column two.

Mr. Tyree, could you put that up on the board for us?

This is PE page 77.

A. Yes, I'm there.
Q. Is it fair to say here that in the Suter and Cormier paper I think you testified about earlier, they say conductivity per se is not the cause of toxic effects, that waters with different mixtures of ions but the same conductivity may have different toxicities?
A. That's correct, it says that.
Q. And then if I turn to -- I think it's Plaintiffs' Exhibit 5, which is the Suter and Cormier paper "Assessing Causation."
A. Yes.
Q. And turn to page 285 of that paper, which I believe is PE 93.
A. All right.
Q. Does it not say, "The causal assessment does not attempt to identify constituents of the mixture that account for the effects"?
A. It says that.
Q. It says the same thing the benchmark does.
A. I can't remember the exact words, but I will take your word for it that it does.
Q. Okay. So if conductivity per se is not the cause, some constituent thereof is the cause? Is that what you're saying? But these reports don't identify what these constituents or attempt to identify a causal link.

A. I'm sorry. Could you tell me what the question is again?
Q. I'll come back to it.
You've testified I think in a couple of other hearings that conductivity per se is not the cause of lowered WVSCI scores, haven't you?
A. No, but that's correct. It's the ionic strength, and conductivity is a direct measure of that.
Q. And what are the -- the benchmark talks about an ionic fingerprint that is typical of the mine drainage they're looking at?
A. Yes.
Q. They mention four primary ions; is that correct?
A. Correct.
Q. Do you remember what they are?
A. Bicarbonate, sulfate, calcium, and magnesium.
Q. Was there a certain proportion they identified as indicative of the mine drainage they were developing the benchmark for?
A. I'd have to re-read the paper. I don't recall.
Q. Do you know what the relative proportions of those four ions are at Stillhouse?
A. I do not.
Q. Are you aware that Dr. King testified in the *Elk Run* case that he believed, when asked which constituents of conductivity was primarily responsible, he believed it was

bicarbonate?
A. I don't recall that.
Q. Have you ever talked to him about that?
A. No, I have not.
Q. Is it fair to say that EPA's confounding factors analysis that you talked about earlier did not individually evaluate either the effects or the confounding -- potential confounding effect of sulfate, bicarbonate, magnesium, or calcium?
A. I don't think they thought that they were confounding. So I don't -- I think you're correct. I don't think they did.
Q. Nor did they separately analyze whether they were potential causes themselves, did they?
A. I can't say they did not. I do not know.
Q. Well, you can't point to anything in those reports that says that sulfate causes impairment in the benchmark, can you?
A. I don't know. I'd have to read the benchmark. I don't recall if it says that anywhere.
MR. MCLUSKY: Mr. Tyree, Defendant's 8. Could you pull that up, which is, I believe, the -- does Dr. Palmer have a notebook of Defendant's 8? She should.
THE WITNESS: Is it the joint or the cross?
MR. MCLUSKY: This is Defendant's.
THE WITNESS: I don't think I have it.
THE COURT: I have a set of the Defendant's here. Which one are you referring to?

MR. MCLUSKY: Defendant's 8, which is the Gauley TMDL.

THE COURT: Do you know which volume that's in, Mr. McLusky?

MR. MCLUSKY: I do not.

THE WITNESS: I don't know. It says Palmer Cross-Examination Document.

MR. MCLUSKY: No.

THE COURT: Did you say the total maximum daily load document?

MR. MCLUSKY: Yeah.

THE COURT: I think those notebooks are down below you to the right.

THE WITNESS: Which volume?

THE COURT: Volume 1, tab 8.

THE WITNESS: Okay.

BY MR. MCLUSKY:

Q. Turn to page 15 of that exhibit. And Mr. Tyree will highlight it for us.

A. Okay.

Q. Can you blow that up?

Is it fair to say that while DEP listed the stream as biologically impaired for ionic toxicity, that because it could not identify the causative ions, it was deferring TMDL development for Stillhouse?

A. I have no idea.

MR. LOVETT: Objection, Your Honor, to the extent he's asking for legal conclusions about what DEP did. It's beyond the scope.

THE COURT: Well, sustained. Rephrase your question.

BY MR. MCLUSKY:

Q. Dr. Palmer, Defendant's 8, does it not end with the statement, "Therefore, DEP is deferring TMDL development and retaining those waters on the Section 303(d) list"?

A. It does say that, yes.

Q. And prior to that, it says that the information available regarding the causative pollutants and their associated impairment thresholds is insufficient for TMDL development at this time, does it not?

A. Yes, it does say that.

Q. Is it fair to say you haven't done any toxicological experiments on insects at Stillhouse?

A. Not at Stillhouse, no.

Q. Okay. Have you conducted any type of statistical analysis yourself to determine the cause of the WVSCI scores at Stillhouse?

A. I'm trying to think if we did them on Stillhouse. If I could look at my notes, I could tell you.

Q. Well --

A. We did do statistical analysis.
Q. Do you know what the WVSCI scores were in the Stillhouse watershed prior to mining?
A. I don't know. I don't know if those data are available.
Q. I'm unaware of any. Is it fair to say the best you know, there are no WVSCI data available prior to mining?
A. It's fair to say I don't know of any.
Q. Have you done any investigation into the impacts of upstream timbering or of the pond that was built in Stillhouse on downstream temperatures or food supplies?
A. I've not done any at Stillhouse. I've only read in the literature about the effect of timbering.
Q. Have you done any investigation into the effects of mining in the Stillhouse watershed on the flow regime or flow patterns in Stillhouse?
A. No. As far as I know, there's no long-term data. If there are, I have not seen it.
Q. And I think you testified earlier that some 90-plus percent of the Stillhouse watershed has been mined or filled?
A. My recollection was that 90 percent of it had been impacted by mining.
Q. Put up Plaintiffs' Exhibit 23, if you could, Mr. Tyree. That's not what I wanted.
A. Okay.
Q. As I understand it, you were -- the place you visited on

Exhibit 23 was -- let's get oriented. We've got ponds up in the upper right. The water is flowing from those ponds into Stillhouse, and then it meets Twentymile Creek to the south.

Is that a fair statement?

A. That's correct.

Q. Okay. And the place you went was all to the north of what appears to be a railroad track or a road to the middle of that?

A. That's correct.

Q. And you did not go to the lower reaches of Twentymile Creek at all.

A. I did not because of the impacts of -- the potential impacts of the road and railroad tracks; I did not.

Q. Well, what potential impacts are the road and railroad track going to have?

A. Well, I only know that the protocol typically for looking at impact work is to stay closest to the impact you're studying and not go below additional ones.

Q. But according to your testimony, a little road and the road crossing aren't going to have an effect on the WVSCI score, are they?

A. Oh, they could affect the WVSCI score; they're not going to lead to impairment.

Q. Oh, okay. So you didn't go in the stream at all, didn't even see it below the railroad tracks.

A. No. I've seen Boardtree just upstream but not there. I've looked at Boardtree where it went into Twentymile.

Q. All right. Let's look upstream a little bit from here.

If you could, show Defendant's Exhibit Number 7, Mr. Tyree.

I assume you've seen this picture before. I believe your lawyers may have provided it. Have you seen this before?

A. I suspect I have.

Q. Okay. Mr. Tyree, could you zoom in on the Defendant's Exhibit 7 on the Stillhouse watershed?

A. Is it in -- is it in one of these documents?

Q. It is. It's Defendant's Exhibit 7.

A. Okay.

Q. Mr. Tyree, could you point to us the toe of the valley fill?

Dr. Palmer, do you see where Stillhouse is noted on this exhibit?

A. I do.

Q. Okay. Now, Stillhouse itself -- almost all of Stillhouse has been filled, hasn't it?

A. It certainly appears that way.

Q. How much is left? Two to three hundred yards below the ponds?

A. Oh, you meant the stream itself?

Q. Right.

A. I don't know how far up it went. So I wouldn't want to estimate the distance. Oh, you mean that's left?
Q. Right.
A. Oh, yeah, probably; you're correct.
MR. MCLUSKY: Just a moment, Your Honor.
This was an exhibit I believe that the plaintiffs showed earlier. I don't remember the number.
THE WITNESS: I recall it.
THE COURT: Can we identify it for the record?
MR. MCLUSKY: It should be Joint Exhibit 18.
THE WITNESS: Yes.
BY MR. MCLUSKY:
Q. Okay. Now, if you look at Joint Exhibit 18, you can see where the original stream channel used to be, can't you?
A. Yes, you can.
Q. Now, is it fair to say the vast majority of Stillhouse was buried by the valley fill?
A. That's correct.
Q. Is it fair to assume based on the photograph we saw a moment ago, Exhibit 23, that the entire watershed has been timbered?
A. Yes, but I do have to ask a question. Normally I think of the valley fill as where there's those cross lines.
Q. Right.
A. But above that, they don't show those. So I didn't know

if that was just cleared flat area or if that was part of the valley fill.

Q. Well, I think this is out of your report, and it says the yellow is the valley fill.

A. Oh, well, I'm referring to the yellow where there's those cross lines.

Q. Don't you believe the stream has been filled above the cross lines? Isn't that just the face of the fill?

A. I honestly don't know because I don't read these regularly.

Q. Are you aware of any remaining portions of Stillhouse that exist above the valley fill that you've seen?

A. Only -- no. That I've seen, no, just a very small amount that's not impacted.

Q. But the amount you saw is below the valley fill, not above it, right?

A. Perhaps. I just read that over 90 percent had been impacted by mining. I didn't do the spatial analysis myself.

Q. Are you aware of any stream segment in the Stillhouse watershed that exists upstream of the valley fill?

A. I know of none.

Q. And you've driven over there, and that whole area has been cleared, timbered, and mined, hasn't it?

A. I haven't driven above the ponds.

Q. There was mined -- the timber was stripped off, wasn't

it?
A. Yes, it was.
Q. All right. Is it fair to say manganese and selenium are not among the four ions that EPA identified that is constituting the fingerprint of mine drainage for the benchmark?
A. I think that's fair.
Q. Okay. But EPA did find that there was a moderation correlation between manganese and extirpation of sensitive macroinvertebrates, didn't it?
A. I'll take your word for it. I'd have to re-read this document.
Q. Have you suggested that particular pollutants such as selenium and manganese can themselves cause stress to aquatic organisms by getting in the food web?
A. Certainly I know selenium can.
Q. Haven't you said that several of the more toxic ions, especially selenium and manganese, are known to accumulate at high concentrations in stream biofilm where they may enter stream food webs?
A. I know that to be the case. I can't remember if I said that in this report or an earlier one.
Q. But that's a fair statement.
A. Yes, I think so.
Q. Okay. Did you do any site-specific work here to see if

manganese or selenium have accumulated in Stillhouse in high ionic concentrations to enter the food web?

A. I did not do food web work.

Q. Didn't the Sierra Club originally claim in this case that Fola was violating the water quality standards for selenium?

A. I don't recall.

Q. You don't recall your report addressing selenium either?

A. It's in this report. Oh, yeah, I know selenium was in there. I don't recall that I said the Sierra Club reported that.

Q. Well, you're working on behalf of the Sierra Club here, correct?

A. I believe that they pay the bills to Mr. Lovett. I don't ever encounter the Sierra Club --

Q. Well, you understand this lawsuit originally included a claim that there was a violation of water quality standards for selenium; is that correct?

A. Yes.

Q. You understand that's been dropped, right?

A. I do not know that.

Q. Okay. Is it your belief that selenium could be contributing, then, to stress to aquatic organisms in Stillhouse?

A. I think it probably could. I don't know.

Q. Temperature. You've referred to temperature and other

things, a couple of others, as master variables before.
A. I usually think of flow as the master variable, but certainly temperature is very important.
Q. Okay. And what does the term "master variable" mean?
A. It's like, you know, you have to get the flow, so -- I just finished giving a talk a few weeks ago where I describe that there's a hierarchy of factors you look for when you're getting ready to restore a stream which tells you what the underlying problem was; and flow is one of those, which is below water quality problems.

So water quality would trump anything. Then you want to look at flow because it controls the sediments, food, all sorts of things.
Q. Okay. Did you do any investigation as to the impact, the hydrologic -- the flow impacts of the mining in the Stillhouse watershed on the flows below the pond in Stillhouse?
A. Only looked at the flow the day I was sampling, but I did not do a thorough investigation.
Q. And that flow comes across a concrete flume, doesn't it?
A. It does.
Q. And that flume is there to retard incision and erosion, isn't it?
A. I don't know why the flume is there; no idea.
Q. That's what they're typically there for, aren't they?
A. I don't know.

Q. The role of multi-metric indices, is it fair to say that generally studies have not been able to link the scores of multi -- of the application of those indices like the WVSCI to specific stressors?

A. I don't know the answer to that.

Q. Weren't you the co-author of a paper for the National Fish and Wildlife Foundation in 2011 entitled "Promoting Successful Restoration through Effective Monitoring in the Chesapeake Bay Watershed"?

A. I was.

Q. Didn't you say in that paper, in general, studies have not been able to link index scores to specific stressors, making it difficult to interpret metrics because communities can show impairment due to a stress, such as hydrologic regime, that is different from the stress that is being evaluated, such as water quality?

A. And the point is that it depends on what is in the multi-metric index, that that whole study was done to establish a relationship between functional change and stressors and what the scientific evidence was relating those two. And so we were basically telling NFWF that we do not advise using multi-metric indices as an indicator of reduced function in the streams they wanted to restore.

Q. Well, didn't you go on in that same report to say that macroinvertebrate indices generally cannot be used to diagnose

a specific problem such as metal contaminants or high nutrient levels because these pollutants are almost always --

THE REPORTER: Excuse me.

THE COURT: Slow down.

THE REPORTER: Start over and slow down.

BY MR. MCLUSKY:

Q. Let's put up -- Mr. Tyree, this is tab 17 of your Palmer notebook, if you would.

A. That looks -- which notebook?

Q. Should be Palmer Cross-Examination.

A. Which volume? Which volume?

Q. I don't know. It's tab 17. I don't have it in front of me. I'm awash in volumes right now. I'm going to trip over them.

A. Yes, I'm there.

Q. If you'll turn to page A-8, paragraph 1.

Mr. Tyree, could you blow that up?

A. What page are you on? I'm sorry.

Q. A-8. "A" as in "apple," dash 8.

A. Okay. I'm there.

Q. And here is it fair to say you're talking about macro-invertebrate indices?

A. Yes, it looks like we are.

Q. Okay. And don't you say here that they generally cannot be used to diagnose specific problems such as metal

contaminants or high nutrient levels because these pollutants are almost always associated with multiple confounding effects?

A. That's correct, which is why you have to do a confounding effect analysis, to eliminate those.

Q. Right. And --

A. Which is what EPA did.

Q. -- you haven't done that here, though, have you, on anything?

A. For Stillhouse?

Q. Have you done it for -- have you done it independently of anything in the benchmark?

A. I'm sorry. Do you mean in any stream in West Virginia?

Q. I mean in a general -- let's go back and --

A. I've definitely done it on the West Virginia database.

Q. We will come back to that later, then.

Dr. Palmer, isn't it fair to say that the removal of trees from the entire watershed, such as occurs during mining, fundamentally changes the form in which the remaining stream receives carbon from a particulate carbon to a dissolved form?

A. Yes, it can.

Q. And haven't you previously told us that that shift in the carbon form caused by tree removal results in the loss of some of the shredder insects?

A. I'm sure I would have said that loss of the particulate

organic matter would result in loss of shredders but not the dissolved component.

Q. Okay. I'm confused. Loss of the particulate portion would result in a loss of shredders. Is that a fair statement?

A. Correct.

Q. And cutting trees --

A. Some shredders, not all of them.

Q. Well, in fact, I think you said you'd lose a lot of the sensitive shredders, right?

A. Where are you reading from? I'm sorry.

Q. Well, I can pull up -- you said this in 2012.

Let's pull up the tab 1 of the cross-examination notebook, which should be your deposition from the *Highland* case.

Mr. Tyree has it up on the board.

A. Yeah, I mean I don't dispute that when you lose the leaf litter, you're -- entirely lose the leaf litter, you're going to lose some shredders. Stillhouse had plenty of leaf litter.

Q. You said the sensitive ones are lost, though, right?

A. Well, if all the leaf litter is lost.

Q. You're saying there's leaf litter because there were some trees below the pond?

A. There were definitely trees below the pond.

Q. So you don't believe the food source in the pond had been

converted from a particulate source to a dissolved carbon source?

A. There was plenty of particulate organic carbon in Stillhouse.

Q. Did you do any measures to look at the relative abundance of a particulate versus the dissolved organic carbon?

A. I did not. As part of the biochemistry work, I did not measure DOC directly, but I often do.

Q. Haven't you told us before that when you take away leaves and wood, the shredders' food supply is gone and you can change the composition of an aquatic insect community in a way that can cause impairment?

A. If all the material is gone. But as I stated several times, there's plenty of leaf litter and even some wood in Stillhouse.

Q. Did you say in your deposition that you thought there was a good chance that nutrient processing has been affected downstream of the pond in Stillhouse?

A. I wouldn't be surprised if it had been.

Q. Did you also say you didn't know what the effects of that nutrient -- changes in nutrient processing would be to the area where Dr. Swan did his sampling?

A. I said I did not know.

Q. Right.

A. Yes.

Q. Is it fair to say that if you put aside the nutrient dissolved -- particulate versus dissolved carbon, that if I just cut the trees, I will tend to warm the pond and the streams in an environment like this?

A. If there's no trees over the stream and you have warm water from the pond, sure, you could increase the temperature.

Q. In fact, you'd expect that to be the case here, wouldn't you?

A. Yes, you would.

Q. That also generally causes a higher rate of what's called primary production in the pond, doesn't it?

A. Metabolism in general goes up, including the rate of primary production.

Q. And that would typically shift the types of bugs you have from a -- or from a food source to an algae-based system, would it not?

A. Well, I should clarify. It would -- primary production would go up if you have sufficient nutrients. Just because light goes up doesn't mean you're going to get an increase in primary production or temperature unless you have sufficient nutrients. Primary production requires nitrogen, phosphorous, sufficient light.

Q. Would you expect there to be greater source of algae in Stillhouse now than there was prior to mining as a result of --

A. Probably some difference in benthic algae.
Q. I think you've also told us before that based on those increased -- increased primary production, you can expect to see a decline in diversity as well too, can't you?
A. I don't know if I said that. Certainly if I did -- you can't say that as a general rule.
Q. But it can occur.
A. Only at excessive levels of primary production which then when the algae die create anoxic conditions. Then you could see reduced diversity. But oxygen was 100 percent saturation in that system.
Q. You have testified about high light environments in mitigation stream channels in the past here, have you not, those where people were trying to create a stream by a hillside?
A. I suspect I did. I don't recall, but I believe you, it would happen.
Q. All right. Do you remember saying that with abundant light and open canopy, algae production rather than leaf litter can fuel the ecosystem?
A. Yes, it can.
Q. And the temperatures may rise in the summer to levels to which native fauna cannot acclimate.
A. Depends on what the temperature levels are. Absolutely. If it exceeds their thermal tolerance, organisms will start

drifting.

Q. Well, you've also said, I think, that you don't know, short of lethal temperature increases, whether temperature increases would affect a WVSCI score, right?

A. I don't know at what point, you're correct, short of thermal tolerances it would.

Q. Okay. Do you recall the *Aracoma* case back in 2006?

A. Vaguely.

Q. That was probably the first time you testified here.

A. It was.

Q. Do you recall there reacting to a statement either by the Corps or a company representative -- I don't recall which -- which said that no substantial effects from ponds will be anticipated to occur on downstream aquatic communities?

A. I don't remember my reaction, but I would expect there to be impacts from ponds.

Q. And those impacts would be on the biodiversity and the types of bugs that exist downstream, wouldn't it?

A. The biggest impact you usually have is that you get pelagic or planktonic drifting organisms from the pond going into the stream.

Q. And that changes the makeup of the insects as well?

A. Well, it's hard to say because most of the planktonic organisms are not what's included in the multi-metric index because they're not native to streams. They're common in

ponds.
Q. So the multi-metric index wouldn't pick up those changes? I'm not sure I follow.
A. So the multi-metric index does not take -- it does not assess organisms like daphnids or other pelagic organisms that might accidentally drift in, correct.
Q. Dr. Palmer, you said flow is a master variable, right?
A. Yes, that's correct.
Q. Haven't you said before -- well, let's see. And the most important aspect of flow for the purposes of impairment would be peak flows?
A. Well, it's actually peak flow and the lowest flow.
Q. Okay. And then presumably changing the velocities of the flows in smaller areas could affect microhabitats as well?
A. Yeah, it could. It doesn't have nearly the effect of the high -- if the historically high velocities are exceeded consistently or the lowest flows are -- occur below those historical levels, then, yeah, it can have a big impact.
Q. So if I do something to increase my peak flows on a routine basis, it can have a significant impact downstream.
A. Only if they're outside the historical range of natural variability.
Q. Right. Now, you've written before, I believe, that peak flows increase linearly with the percent of watershed mined even if the land has been reclaimed, haven't you?

A. I don't recall that. It may be that that's work that Eshleman did sometime ago, but I haven't looked at that in a long time.

Q. Well, let's look at -- I think it's Plaintiffs' Exhibit Number 1.

A. Okay.

Q. And if I turn to page 45 of the report, which is PE 7, second column -- Mr. Tyree can probably show that to us quicker than I can.

Is it fair to say that in this article you say that peak flows increase linearly with the percent of the watershed mined?

A. I'm sorry. What page are you on?

Q. I'm on page 45 of the article.

A. Right column?

Q. The right column, I think.

A. Top?

Q. It's under "Altered hydrology," lower right paragraph. Do you see that?

A. Oh, okay. Yes, I do see that.

Q. If you read down there, I think you'll see it.

Can you confirm or read for me the sentence that starts with "Peak flows"?

A. I can confirm that recent works of the study that we cite found peak flows increasing linearly with the percent of the

watershed mined.
Q. I think you testified before that some 90 percent of the watershed had been mined here, right?
A. That's correct.
Q. So -- or at least 90 percent. You couldn't get much more in terms of your increase on the peak flows, right, in a watershed?
A. Well, actually that's not the case. First of all, you'd have to look at the peak flows historically; and second, you don't have the vertical gradient that you had before the mining was done. And so there's a very good chance that the peak flows the stream experiences now are not higher than the historical range of peak flow during storms.
Q. What does the article say? The article doesn't say that. It says peak flows increase linearly with the percent of the watershed mined, even if the land has been reclaimed, doesn't it?
A. I said that that's what that study showed. I'm simply giving you an analysis of what I've seen at Stillhouse, which is it's a very gentle slope. It's not the steep headwater slopes.
Q. Where are we talking -- you didn't get above the valley fill, the face of the fill you said. So what did you look at?
A. Correct. I'm talking about what the stream slope was where I --

Q. Oh, the stream slope. Okay. Okay.
A. So a couple things. One, water comes down that chute.
Q. Right. I'm not -- I understand.
A. And drop --
Q. I understand. I just wanted you to --
A. Drop reduces velocity.
THE COURT: One at a time. Hold on.
BY MR. MCLUSKY:
Q. I just wanted you to confirm what was said in this report.
A. And I did, but I said that it dealt specifically with that one particular study.
Q. This paper -- turn to page 1, Exhibit 1. Tell me what the title of this paper is.
A. It is "The environmental cost of mountaintop mining valley fill operations for aquatic ecosystems of the Central Appalachians."
Q. This doesn't represent that it's the study of one site. It represents that it's the cost of mountaintop mining generally, doesn't it?
A. That is not what the sentence says. If you read the sentence, it's very clear that it is referring to a specific study.
Q. I understand that.
A. It says recent work, and it cites one article.

Q. The sentence before that says mining also leads to significant changes in watershed hydrographs, doesn't it?
A. That's correct.
Q. Then without qualification, it makes the statement that peak flows increase linearly with the percent of the watershed mined, even if it's been reclaimed, doesn't it?
A. I have not denied that mining will alter hydrology. I simply said in Stillhouse, because of the gentle slope and the drop -- step pools are used to reduce flow in urban streams when peak flows go way up. And essentially the chute has created a step pool where the energy drops down very, very quickly before it goes into the stream.
Q. Have you done any measure at all -- you're not an engineer.
A. Actually I've worked on boundary layer flows and hydrodynamics for my Ph.D.
Q. And there's all kinds of modeling that people use in order to evaluate what impact in the peak flows is going to be, aren't there?
A. Absolutely.
Q. Did you apply any of those at this site?
A. I did not, but I did look at flow in the stream, and I looked at slope.
Q. You looked at the slope in the stream, though.
A. Well, that's where the relevant point is here that we're

talking about.
Q. But the peak flows are coming from the mined areas to the stream, are they not?
A. Yeah, and there's a drop. Physics tells us when you have a drop and the area widens, the conservation of momentum is such that flow is going to drop significantly, velocity is.
Q. Can't repeated increases in peak flows cause impairment?
A. If they're outside the historical range of flow variability for the site.
Q. Haven't you also said in the past that many sensitive indicator taxa used in multi-metric indices are so sensitive to degradation that their return typically requires almost full restoration of ecological processes such as flow, sediment regime, and food base?
A. As I said before -- and I've talked about this extensively and published -- you have to use a hierarchical approach and look at the most limiting factors.
Q. Well --
A. Can I finish my sentence?
MR. LOVETT: Your Honor, Mr. McLusky has interrupted her repeatedly.
THE COURT: Let her finish her answer.
THE WITNESS: If the water is too polluted for organisms to live, it doesn't matter what the flow levels are or the habitat. They can't live there. And numerous studies

have manipulated in restoration projects the flow using structures and increasing habitat and you still don't get the organisms back because the water is polluted.

BY MR. MCLUSKY:

Q. Now, my question to you, though, in order to restore a WVSCI score as measured by the multi -- as measured by the WVSCI test, isn't it fair to say that you would require full restoration of ecological processes such as the flow, the sediment, the temperature regime, and the food base?

A. To get full ecological restoration of all processes, biogeochemical, etcetera, you would have to restore all of those.

Q. Did you not tell Congress in 2009 that there are now a number of peer-reviewed scientific studies documenting the fact that hydrologic regime -- that is, the source, timing, and amount of water flow below mined sites -- is fundamentally altered?

A. Yes, and I have not denied today that I'm sure there's some alteration to the hydrologic regime. There's no evidence it's outside of the historic range of variability at the site that we're discussing.

Q. Except for the fact that you published a paper that says that peak flows increase linearly with percent of mining, right?

A. No, I didn't publish that paper. I quoted someone else

who measured that at one site. Just because there's a linear relationship at one site doesn't mean it's at all sites.

Q. Dr. Palmer, that paper, Exhibit 1, Dr. Bernhardt and Dr. Palmer are the only authors of this paper.

A. That's correct.

Q. And you're saying this quote was not intended to characterize mining generally but when you're talking about a single site?

A. There may be many more sites that respond linearly. I don't know that those sites have step pools. I'd have to go back and look at this. If this is the work in Western Maryland streams, they don't look anything like the sites we're talking about at Stillhouse.

Q. But there aren't any mountaintop mining sites with valley fills in Maryland, are there?

A. I don't know.

Q. Well, you represented in this article that this was indicative of mountaintop mining valley fills in Central Appalachia, didn't you?

A. No.

Q. You didn't?

A. I said recent work. That means a paper I'm citing analyzing hydrologic change as a function of the amount of watershed, etcetera, etcetera. I did not say all mine sites increase linearly. We don't have the data to show that.

Q. You don't even identify the particular mine site here, do you?
A. I site Ferrari et al.
Q. Okay. What do their papers say?
A. I haven't read it in many years. If you want to get it for me, I'll be glad to read it.
Q. Mr. Tyree -- do you remember you provided some testimony to Congress back in 2009 to the Senate Environment and Public Works Committee? Do you remember that?
A. I do.
Q. It's at tab 2 I think of your Palmer Cross-Examination notebook. You can turn to page 3 of that. Mr. Tyree has it up.
A. Sorry. I'm having a hard time finding it. What volume is it?
Q. It's tab 2, so it's probably volume 1. Mr. Tyree can show you the first page if you'd like.
A. It must still be in the box. Let me look. Volume 2. Is it the one that said Defendant on it?
Q. No. It should say Palmer Cross-Examination.
A. I don't think I have that. Maybe someone from your team can look and --
MR. MCLUSKY: May I approach, Your Honor?
THE COURT: Yes, you may.
THE WITNESS: Okay. Tab 2.

MR. MCLUSKY: Yes.

BY MR. MCLUSKY:

Q. Dr. Palmer, can you confirm that you've provided testimony to a subcommittee on water and wildlife, the Committee of the EPW or Environment and Public Works Committee that --

A. I did, yes.

Q. And turning to page 3 of that testimony, could you confirm that you said since the flow regime is one of the key variables in determining what types of insects and other aquatic organisms can live in a stream, even if the water coming out of valley fills could be purified before entering the streams, the biological community will never be the same?

A. It may not have exactly the same constituents. That's absolutely true. It doesn't mean it will be impaired, though.

Q. But that's not what you told Congress. You said it will never be the same. You weren't saying except it will meet the WVSCI score, were you?

A. I was instructed to keep this extremely short. In fact, I was asked to cut it and cut it and cut it by the committee, I guess, staff members. So, no, I didn't put a lot of those details in.

Q. Well, what you meant by this was even if you purified the water, the landscape style effects upstream are going to cause fundamental changes in the biology downstream, didn't you?

A. I've said many times hydrology influences the organisms. I have no doubt you may see a shift in species composition, but I absolutely don't have any reason to know if you would have impairment. It would depend on how much the hydrology changed compared to what the organisms evolved in response to; that is, their historic range of variability. And these streams, these deep streams have very high, deep flows during rain storms.

Q. Mr. Tyree, could you show us Defendant's Exhibit 5B?

I just want to walk a little bit -- it's probably easier to look. This one is easier to look at on the screen I think.

A. Oh, yes. This is from the site.

Q. Is this a view of the pond or one of the ponds at the headwaters of Stillhouse?

A. It is.

Q. Okay. And then I'm just going to kind of walk you downstream to see if it's consistent with your memory of being there.

If you go to Joint Exhibit 8, I think we should have a picture of something called the flume. Do you remember this downstream of the pond?

A. I do. It looks pretty different because there was snow, but yes.

Q. Okay. So the pond here, I believe this is actually off of -- either from Meghan Betcher or Mr. Hansen's pictures.

The pond is in the foreground, as I understand it, even though it's kind of an optical illusion to me. But as I understand it, this water is moving from the right foreground into the left background.

A. Oh, is that right? I thought it was coming down. It's hard to tell, but I trust you. I don't know.

Q. In any event, is there a date on this photograph? Okay. This is -- I think this is taken by Miss Betcher, who works for the plaintiffs here, September of 2013.

A. Uh-huh.

Q. Mr. Tyree, could you zoom back out for a moment?

This is a pretty healthy volume of water coming off there, isn't it?

A. Uh-huh. Yes, it is.

Q. Might be the reason there's a concrete flume, right?

A. Could be, and the reason there's a drop and a plunge pool at the base of it.

Q. Is there some kind of a road crossing between the pond and the flume? Do you remember a road actually crossing?

A. Yes. It looks like when the pond fills, it goes I believe right over the road into -- you know, it's gravel.

Q. Okay. Mr. Tyree, could you show us Joint Exhibit 6?

I think what you're seeing here, if I'm not mistaken, is a road crossing a -- a horizontal line with the pond discharges before it enters the flume. Is that consistent --

A. I think that's correct, yes.
Q. Then in the remaining reach, as I understand it, below the flume, you go through an open channel and then a series of culverts that cross under roads, railroad, maybe another road, and then ultimately into Twentymile; is that correct?
A. That would be -- yes, below the area I sampled. Correct.
Q. Let's look at the Defendant's Exhibit 37, Mr. Tyree, which I think is part of Joint Exhibit 81.
A. Is that probably my --
THE COURT: Which are you asking her to look for?
MR. MCLUSKY: I'm looking for Defendant's 37.
THE WITNESS: Which volume was that?
THE COURT: Which volume?
THE WITNESS: Volume 4, maybe?
MR. MCLUSKY: It's on tab 27 of the cross. I don't know if Mr. Tyree put it in the notebook.
THE WITNESS: Yes, I found it. I have it. Okay.
BY MR. MCLUSKY:
Q. Have you seen this document before?
A. You know, I suspect I have, but I don't recall for sure.
Q. Okay. Look across the top and see if you can't agree with me that this is a watershed assessment form issued by the West Virginia DEP as a result of a site inspection in May of 2012.
A. That's what it looks like.

Q. Okay. You've seen sheets like this before?
A. Yes, I have.
MR. LOVETT: Bob --
MR. MCLUSKY: Yeah?
MR. LOVETT: -- I'm sorry. What page is it?
MR. MCLUSKY: It's the first page of --
(Counsel conferred privately off the record.)
BY MR. MCLUSKY:
Q. So I'm looking on Defendant's 37. It says Stillhouse page 1064 in the lower right. Do you see that? There's a paging --
A. Yes, I do see that.
Q. Now, this appears to be a drawing of the lower end at least of Stillhouse, doesn't it?
A. It does.
Q. Okay. And if I look at this drawing to get oriented, I think when I've looked at this, the ponds would be off to the right, perhaps off of the drawing altogether, and Stillhouse would be to the left --
A. Yes.
Q. -- off of the drawing altogether; is that correct?
A. Yes.
Q. And then we have railroad tracks going up the center, correct?
A. Correct.

Q. And my understanding is you did not go downstream of those railroad tracks at all.
A. That's correct.
Q. Okay. Now, so this form is dated -- can you confirm up in the top line -- May 9 of 2012?
A. That's correct. It looks like -- well, it's hard to say. It looks like "9" might have gotten erased and corrected --
Q. Okay.
A. -- but it looks like 5/9/12.
Q. All right. And then if I want to walk from the downstream end of Stillhouse to the upstream end using this drawing in Exhibit 37, is it fair to say the first thing I see is a dirt road on the left that the stream goes under?
A. Yes, I guess that's what it says. Did you mean road ditch or --
Q. No, it says --
A. Dirt road.
Q. -- dirt road.
A. Yes.
Q. There's a road ditch as well, you're right. Then I see "culvert."
A. Yes.
Q. And then I see "old stump" and then the word "erosion" next to that.
A. Yes.

Q. And then to the south of that, I see "steep eroding bank."
A. Yes.
Q. And then further upstream, but before the railroad tracks, I see "undercut bank."
A. Yes.
Q. Okay. And then I cross the railroad tracks, apparently cross power lines as well.
A. Yeah.
Q. Okay. Did you get down to the power lines?
A. I think we passed them driving in. I didn't walk there.
Q. If I could turn two pages -- several pages ahead to page 1067.
A. Yes.
Q. Mr. Tyree, could you zip ahead? Go ahead and show us first, if you would, the General Comments section.
Do you see that, Dr. Palmer?
A. I'm sorry. What?
Q. The General Comments section.
A. Yes. Yes, I do. Yes.
Q. Can you confirm that near the end, the statement "Lower 40 meters has erosion undercutting in sharp bends. Poor buffer"?
A. I'm sorry. I don't know why -- I don't see where you're looking. You're on 67?

Q. I'm on 1067 under the General Comments section.
A. Right.
Q. You'll see the last sentence is, "RDP almost identical to the LDB." About two lines above.
A. Yes, I do see that.
Q. Okay.
A. And then two sets of railroad tracks, some herbs and shrubs around 80 to 100 meters before stream flows into culvert.
Q. We're going to come back to this in a minute or two, but your trip in January 2014, you saw some staining I think you said earlier?
A. Yes.
Q. I think you said earlier those were orange precipitates on the stream?
A. Well, they were more blackish-green. Some were orange.
Q. I thought you said in your deposition you thought it was iron hydroxide.
A. It probably was iron hydroxide, but the color varied. Some of it to me looked like manganese, but that's the reason I had it geochemically analyzed, because I wasn't positive.
Q. As I understand it, the -- was it the precipitates that were causing some embeddedness, patchy embeddedness you said earlier?
A. That was my guess, yes.

Q. Okay. In your deposition, Mr. Harvey asked you whether this stream would receive a WVSCI score of 68 if you had treated the conductivity to 300 or below.

Do you recall that?

A. I don't recall, but I will believe you.

Q. And do you recall that your answer was that it may pass, and then you said, "I think it would"?

A. And I still do.

Q. But you don't know, do you?

A. I don't know of any studies that have actually cleaned up the water so that we've had a chance to measure it on mine sites, but I do know from acid mine drainage, if you deal with the acid and clean up the water, you definitely recover from impairment.

So there's a lot of other studies where there's water quality problems that have been cleaned up.

Q. Well, Mr. Harvey asked you what you would do to restore the stream. I think you said first that you would plant trees over the entire watershed, right?

A. No, the first thing I would do is take care of the water quality. It would have to be filtered. And then as you actually start restoring the stream, not just cleaning up the water that flows into it, yeah, I would plant trees.

Q. And the reason you said, that would slowly over time restore the hydrology, right?

A. It would.
Q. Which means the hydrology needs to be restored, right?
A. That's -- well, sure. I've never said that hydrology doesn't matter and that it wouldn't affect WVSCI. I simply said I don't think it would affect it enough to cause impairment, which it was only the hydrology and it wasn't outside the historic range of variability.
Q. Can you point me to any studies, either the Exhibit 1 we talked about that you and Dr. Bernhardt published, that says that the changes in flows that you expect in a mine won't cause impairment?
A. I don't know of any such studies, no.
Q. I think you said also that planting trees would correct any changes to nutrient cycling or water chemistry caused by deforestation?
A. It would -- it could improve it.
Q. That would take decades, though, right?
A. Yes, it would.
Q. Many, many decades, correct?
A. Well, actually there's a large study done by Orzay (phonetic) where even restoring the riparian zone within about 20 -- 15 to 20 years, you start seeing dramatic improvement in the biota.
Q. That's still a decade and a half-plus, right?
A. Yes. Yes. It's very severely impacted by mining.

Q. You said also you'd get rid of the pond because it probably has different types of organic matter coming out of it than does a reference stream?
A. Yes, I believe I said --
Q. And you understand that you can't get rid of that pond if you're still treating water?
A. No, I don't. No, anything really about the actual engineering process by which the water is purified, I only know it needs to be done.
Q. Have you ever seen a reverse osmosis plant at all?
A. A plant?
Q. Yeah.

MR. LOVETT: Objection, Your Honor. This is well beyond the scope of direct and something that she's not qualified to testify about, hasn't testified about, and it's not in the report or --

MR. MCLUSKY: Well, I believe in her report she actually opined that the site would return to a passing WVSCI score if the conductivity was reduced.

THE COURT: Well, overruled.

THE WITNESS: Can I respond?

MR. MCLUSKY: No. I don't think there's a question outstanding right now.

THE COURT: Did you answer his question? I think he just asked you if you'd seen a reverse osmosis plant.

THE WITNESS: No, I've never seen a plant.
BY MR. MCLUSKY:
Q. Have you ever seen any type of water treatment plant that has to normalize or equalize flows?
A. A plant? Well, certainly I've been involved in restoration projects where structures are used to restore the hydrologic flow regime. Yes, I have seen --
Q. I'm talking about water treatment, treatment for conductivity, for example.
A. I don't know that they usually combine dealing with the hydrology with the water treatment. They're usually done separately. And the hydrology is usually controlled by a vertical structure because, as I said before, when you have the drop, you can alter the momentum, which changes the velocity.
Q. Don't you have to have -- well, let's go back to Defendant's Exhibit 37, which is the DEP assessment sheet.
THE COURT: Volume 4.
THE WITNESS: Thank you.
THE COURT: At the very back.
THE WITNESS: So what was the tab?
THE COURT: 37.
MR. MCLUSKY: 37, I believe.
THE WITNESS: Okay.
BY MR. MCLUSKY:

Q. All right. And if you'd turn to page 1066 of that exhibit.
A. Yes.
Q. Is it fair to say here DEP notes, under Sediment Notes and Comments, thick cementing of substrate in many places by some type of manganese or Mn hydroxide?
A. I do see that, yes.
Q. Have you ever seen this before?
A. And that would be consistent with him saying, "I saw a greenish-black material in some areas."
Q. Right. But they say "many places." You talk about patchiness. This says thick cementing of substrate in many places, does it not?
A. I don't know the difference between "many places" and "some places."
Q. Well, let's look above because we have a rating system here. Do you see it says Rate Sediment Deposits?
A. Uh-huh.
Q. And it has a score from zero to 4, with 4 being extreme.
A. I'm sorry. You're looking at sediment deposits?
Q. I'm looking right above the sediment notes.
Mr. Tyree could probably point it out.
A. So where it says Silt and Fine Gravel? Is that where you're looking or just looking at the manganese?
MR. MCLUSKY: Back.

BY MR. MCLUSKY:

Q. Do you see where it says Rate Sediment Deposit?

A. Okay. Now I do see that, yes.

Q. You're asked to rate the sediment deposits. There's a scoring system from zero to 4?

A. Yes. Yes.

Q. Now, if I look over to the right, I see Manganese (Black Hydroxide) with a 4, don't I?

A. Yes. And I don't know where they did this exactly in the stream.

Q. They rated it extreme, didn't they?

A. They did.

Q. All right. They have long/lats on the first page of this document. Did you happen to plot this at all on a map?

A. I didn't. So I don't know if this is above or if it's immediately below. I have no idea where it is.

Q. Okay. If I turn, then, to page 1068, if you would.

A. Okay.

Q. Can you confirm this appears to be an RBP form?

A. It's parts of an RBP, yes. It's the beginning of one.

Q. How many -- if you'd go to the next page, is that --

A. Yes, it's clearly an RBP.

Q. Okay. Let's look at the score for epifaunal substrate, the first score. They give it a poor, a 3, don't they?

A. They do.

Q. All right. And then under Embeddedness, they give it a poor with a 2, correct?
A. Let me just look at it for a second, please.
Q. Sure.
A. Right. And so I had a chance to look and see where it was, and they indicated a lot of disturbance related to the mining and the railroad and the culvert and the dirt roads.
Q. Right, but my question is -- let's go back to number 2 under Embeddedness. They give it a rating of 2, don't they?
A. They do.
Q. Now, presumably it's downstream of the railroad would you say?
A. That's what it appears to be. I was trying to see if they marked it on the map, but I don't see that.
Q. But the notation for embeddedness also says metal hydroxides, doesn't it?
A. It sure does.
Q. Let's turn to page 1070, if we could.
A. Okay.
Q. Now, at the top you'll see it says Benthic and Fish Habitat, Aesthetic, and Remoteness Ratings. Do you see it at the very top?
A. Oh, benthic habitat, invertebrate substrate? Is that what you're looking at?
Q. I'm talking about the very top.

A. Yes, I do.
Q. Okay. This appears to me to be a supplemental part of the DEP form that is not part of the standard RBP, isn't it?
A. That does, yes.
Q. Okay. In fact, if I go back one page to page 1069 -- do you see that?
A. Yes.
Q. The prior page. You'll see there's a total score for the RBP in the lower left-hand corner --
A. Yes.
Q. -- of 94.
A. Yes.
Q. Okay. And that comes out as marginal, doesn't it?
A. That sounds about right.
Q. Well, don't take my word for it.
A. No, no. I mean I've forgotten what the cumulative score is, but I believe you. Yeah, it's a bad -- it's not a great score. It's not poor, but it's certainly not suboptimal.
Q. If I look over two blocks, three blocks to the right, you have optimal, suboptimal, marginal. Do you see the scoring system there?
A. Yes, I do.
Q. Okay.
A. Yes, absolutely. I'm sorry.

Q. All right. Now, let's go, then, to page 1070 where we have this kind of supplemental form that DEP has.
A. Yes.
Q. Can you confirm for me there that DEP actually has its own category for benthic macroinvertebrate substrate, doesn't it?
A. They do, and they rated it poor.
Q. With a 2, right?
A. That's correct.
Q. 2 out of 20. Now, if I go to page 1072 --
A. Yes.
Q. -- and you'll see -- Mr. Tyree, if you want to pull that up.

There's a description section, second to the bottom. I'm pointing to it. Do you see where it says "CB in some areas"?
A. Yes, I do.
Q. Okay. Can you confirm for me that they also say here, "All larger substrate coated in some sort of precipitate or flocoulant, basically binding it together. I could only move and scrub three to four pieces of substrate"?
A. I see that. It's certainly not what I observed, but I do see it.
Q. Right. But they were further downstream than you, perhaps.
A. I guess, yeah. I don't know.

Q. Well, overall very poor is what they say, right?
A. It's what they said, yes.
MR. MCLUSKY: Your Honor, if I might, I'm trying to find some photographs.
THE COURT: All right. Take your time.
(The Court and court reporter conferred privately off the record.)
THE COURT: Excuse me. We'll go ahead and take a brief recess at this time, about a ten-minute recess.
MR. MCLUSKY: Sure. I'm almost finished.
(Recess from 2:50 p.m. to 3:06 p.m.)
MR. BECHER: Your Honor, before we begin, if I may -- and I discussed this with defense counsel -- Dr. Palmer had shoulder surgery earlier this year and is having some pain picking up notebooks. They have no objection if I approach and help her handle them.
THE COURT: Certainly.
MR. BECHER: Thank you, Your Honor.
BY MR. MCLUSKY:
Q. Dr. Palmer -- and I think I don't need any more notebooks, but Defendant's 37, which was the stream assessment sheet you were testifying about a minute ago --
A. Yes.
Q. -- to the extent that talks about heavy manganese, hydroxides, and sedimentation in the stream, that's different

conditions than you saw on your site visit. Is that a fair statement?

A. Yes, it is.

Q. Okay. And to the extent there were metal hydroxides downstream of where you were, they wouldn't be the result of the railroad or the road, would they?

A. They shouldn't be. They might be exacerbated if there's a lot of silt.

MR. MCLUSKY: I think that's all I have, Your Honor.

THE COURT: All right.

THE WITNESS: Would you --

THE COURT: Redirect?

THE WITNESS: Oh, yeah.

MR. LOVETT: I need somebody to help me with the books too.

REDIRECT EXAMINATION

BY MR. LOVETT:

Q. Let's stay on the same exhibit just to -- do you still have the sheets before you?

THE COURT: Plaintiffs' 37?

MR. LOVETT: 37.

THE COURT: I mean Defendant's 37.

BY MR. LOVETT:

Q. Defendant's 37. Page Stillhouse 1064.

A. Thank you. Yes. Okay.

Q. Okay. Also Plaintiffs' Exhibit page 363, which is the map that Mr. McLusky was just using as well.

THE COURT: Plaintiffs' Exhibit which?

MR. LOVETT: Page 363.

MR. BECHER: Which tab is that, Joe?

MR. LOVETT: It is tab 23. I'm sure it's somewhere else too, but that's where I know it to be.

THE WITNESS: I can hold it.

BY MR. LOVETT:

Q. Okay. Do you see that map?

A. Yes.

Q. Okay. So let's try to understand where the DEP was doing its work here. Do you see at the very top on page 1064 it says site verification, stream location, Stillhouse; and then it says near mouth? Do you see that at the very top of the page?

A. Yes, I do.

Q. So this was taken -- these were taken near the mouth of Stillhouse --

A. They were.

Q. -- correct?

A. Yes.

Q. Okay. And if you look at the drawing, it says "US" on the right-hand side of the page, again on 1064. That's upstream, right?

A. That's correct.
Q. So the stream is flowing downstream from there into the tracks, and they're sampling on the other side of the railroad tracks, correct?
A. Oh, yes, I see now. I get the orientation. Yeah.
Q. Is that your understanding of that?
A. So the pond is to the left, is that correct, of the page?
Q. Okay.
A. I don't know.
Q. I -- okay. But where is the mouth of this stream?
A. Well, it's going to be at the confluence of Twentymile.
Q. Okay. So it's down towards Twentymile.
A. It's way downstream, yeah.
Q. And then if you look at page 1066, two pages on --
A. Yes.
Q. -- it says reach location, and it starts zero meters and goes to 40 meters. Do you see that at the bottom --
A. I do, yes. Yes.
Q. So does that indicate to you that the samples were taken from the mouth 40 meters upstream?
A. Well, that's what it suggests.
Q. Okay. So that's in a much different location. That's significantly downstream from where you took your samples, right?
A. Yes, very much so.

Q. And it's below the railroad tracks and below those other --
A. Yes, it is.
Q. -- disturbances, right? Now, where you were -- and let me ask you one other question. Can you look at page 1066 of that same document, and the top boxes, one says sediment deposits. Do you see that box?
A. Yes, I do.
Q. Do you see the very bottom? It says probable source.
A. Mining.
Q. Mining?
A. Yes.
Q. Is there any other mine there except for this mine that you're testifying about?
A. No, there's not.
Q. About the manganese deposits, do you know what a manganese deposit looks like?
A. It's a greenish color, greenish-black.
Q. Did you see that in the stream?
A. Oh, absolutely.
Q. Okay. And do you think that at the part of this stream where you and where Dr. Swan -- where you sampled and where Dr. Swan took his samples, was that material there?
A. It was there, yes.
Q. Was there a lot of it?

A. There was a lot of deposits. All areas weren't embedded. So there were patches of embedded areas, as I said earlier, but --

Q. Are those deposits related to the ions associated with conductivity?

A. Yes, they are.

Q. Let's look at plaintiffs' exhibits and then start with 15. It's the Pond 2008 paper that Mr. McLusky was asking you about.

A. Yes. Okay.

Q. And if I recall, Mr. McLusky was questioning you about whether this paper associated ionic pollution with impairment or not.

Do you recall that line of questions?

A. Yes, I do.

Q. Would you please turn to PE 210, page 210 of that document.

A. Okay.

MR. LOVETT: Your Honor, let me just -- we've tried to reach an agreement with defendants about not having to read all this into the record and admitting these exhibits, but we haven't been able to reach an agreement. So, unfortunately, I think there's going to be some reading into the record from these articles.

THE COURT: That's fine.

MR. LOVETT: Okay. I apologize in advance for that.

BY MR. LOVETT:

Q. At page PE 210, the very first paragraph, "Our results," could you read that, please?

A. "Our results confirm that mountaintop mining impact to aquatic life is strongly correlated with ionic strength in the Central Appalachians, but habitat quality did explain some variance in MMIs and other metrics."

Q. Okay. So this is in 2008, right?

A. Yes.

Q. And back in 2008, Pond was already associating the impairment with ironic stress, correct?

A. He was.

Q. Okay. Also, Mr. McLusky pointed you to the bottom of page 211, PE 211.

A. Yes.

Q. It says, "Our bioassessment indicators were not strongly correlated with dissolved or total metals concentrations."

Do you see that?

A. I do.

Q. Sulfates is not a metal, is it?

A. No. Well --

Q. So that's not addressing sulfates and the ions associated with conductivity, is it?

A. That's correct.

Q. Now, he also had you look down at table 4, and the embeddedness score under the WVSCI was fifth, I guess, .57. Does that mean -- what does that mean?
A. Well, it means there is, you know, an influence or a relationship between embeddedness and WVSCI.
Q. Okay. And but what about with specific conductance?
A. It's just a much stronger relationship. The value of those numbers represent the steepness of the slope relating the two variables.
Q. And is this paper, if you remember, based on the DEP database or on samples of particular mined watersheds?
A. No, this is based on field sampling of specific watersheds.
Q. Okay. So in this specific case, you found the sediment deposition score and the embeddedness score, but that's only at these sites, right?
A. That's correct.
Q. Okay. Do you see page 215, the first paragraph?
A. Yes.
Q. Would you read the first sentence of that, please?
A. "Water quality structured benthic communities more than habitat quality."
Q. And do you know what he's talking about when he's talking about water quality there based on the rest of the article?
A. Yes. He's talking about the ionic composition of the

water.

Q. Okay. So if -- and then the next sentence, please.

A. "Our study and others" -- and he cites a series of studies -- "suggest that specific conductance is the best predictor of the gradient of conditions found downstream of alkaline mine drainage and valley fill sites in the Central Appalachians."

Q. Okay. Did you see alkaline mine drainage at Stillhouse?

A. Absolutely.

Q. Okay. And then it's not true, is it, that this article does not draw a relationship between ionic stress and impairment?

A. This article definitely draws a relationship between ionic stress and impairment.

Q. Can I turn your attention to the next article that Mr. McLusky asked you about, which is tab 16, a Pond paper in *Hydrobiologia*. And if you would look at page 233. Mr. McLusky pointed you to line 593. Do you remember that?

A. Yes.

Q. And it says -- and I think he had you read this statement, "Although Pond et al. did not find strong correlations of mayfly abundance and enrichment with mining-related trace metals in the water column, they state that possible exposure to metals through dietary uptake or potential microbial -- potential microhabitat smothering by

metal hydroxide precipitate or iron bacteria blooms could not be ruled out."

Do you see that?

A. I do.

Q. Okay. What do you think of that statement based on the rest of your testimony here?

A. Well, first of all, I do think that there is a relationship, a strong relationship between metals in the water column and the mayfly abundance. You know, this is just one subset --

Q. But the --

A. It's the other factors also.

Q. Sulfates aren't metals, are they?

A. You know, I need to look that up. I don't think so.

Q. If they're not, this sentence doesn't really affect that, right?

A. Well, I guess that's true.

Q. Has a lot of research been done since the Pond 2008 study as well to support the opinions that you've expressed here?

A. A tremendous amount of work has been done.

Q. Would you read the next sentence too, please?

A. "Analyses from West Virginia mining areas" -- and he cites Hartman, Merricks, and Pond -- "indicated that the decline of mayflies from mountaintop mining correlates most strongly to specific conductance."

Q. Again, that supports your testimony here today, doesn't it?
A. It does.
Q. Now, Mr. McLusky also turned your attention to tab 17, PE 240. Do you see that?
A. Yes.
Q. Particularly the sentence beginning at the bottom of the first column and continuing on to the second column, beginning "Species richness." Would you read that sentence, please?
A. Beginning "Core caddisfly genera"?
Q. I was talking about the next sentence, but "Species richness." Is that a new sentence?
A. Yes. "Species richness was significantly higher at reference sites and reference site mean tolerance value was lowest compared to all other categories."
Q. That doesn't surprise you, does it?
A. No.
Q. You'd expect -- you would expect species richness to be higher at reference sites.
A. Yes, particularly because you have mayflies there.
Q. On page 250 of the same article, the sentence beginning at the end of the second column, at the end of the page there, beginning "Spearman."
A. Yes.
Q. Would you read that passage?

A. "Spearman correlations revealed that habitat factors related to the quality and quantity of substratum (i.e., epifaunal substrate quality and degree of embeddedness) and streamside forests (riparian zone width and bank vegetative quality) were strong and significant drivers of richness."

Q. You agree with that, don't you, generally?

A. Yes. Habitat is important generally.

Q. Okay. Would you continue?

A. "However, no habitat factors were significantly correlated with relative abundance metrics. Additionally, major ion concentrations (measured as specific conductance) were also highly correlated with Plecoptera and Trichoptera richness but not abundance."

Q. Again, is that consistent with your testimony on direct?

A. Yes, it is.

Q. Okay. And Mr. McLusky asked you a series of questions about tab 19. Would you turn to tab 19, please?

A. Okay.

Q. And that's the 2014 Pond et al. document that you testified about on direct; is that correct?

A. That's correct.

Q. And on page 298 of that document, or PE 298 --

A. Yes.

Q. -- would you read the paragraph -- the last paragraph of the -- Mr. McLusky was asking you questions about this. The

last paragraph of the page.

A. Beginning "Overall"?

Q. Yes.

A. "Overall, biological variation was strongly correlated with water chemistry and less by reach-scale habitat and landscape conditions. Since ion concentrations explained the greatest amount of biological impacts and were the most altered (compared to reference), this suggests that recovery is potentially hindered by ions, even in forested reaches long after reclamation."

Q. And then turn the page, if you would, to page 299.

A. Okay.

Q. And the paragraph -- the next paragraph beginning "Simple land use change."

A. "Simple land use change (i.e., percent forest loss) was certainly tied to the environmental degradation we observed, but exclusive to our 15 valley fill sites, biological variation was not significantly correlated to land use features."

Q. Would you continue?

A. "This latter observation adds uncertainty in applying land use thresholds for managing aquatic resources when streams are already compromised by varying water quality problems, like elevated specific conductance."

Q. Okay. Continue, please.

A. "Specific conductance is often used as a simple but robust measure of mine pollution (e.g., Rikard and Kunkle 1990) and biological effects from mine pollution in this ecoregion (e.g., Pond et al. 2008; U. S. EPA 2011b). Cormier et al. (2013b) and Suter and Cormier, 2013, provided strong causal evidence that Appalachian macroinvertebrate extirpation is linked to increasing ions (as specific conductance), a finding supported by our study."

Q. Do you agree with that statement?

A. I do agree.

Q. I mean you agree that mine -- that specific conductance is a problem for -- strike that.

You agree that macroinvertebrate extirpation is linked to increasing specific conductance, right?

A. I think there's no question about that.

Q. Now, let's turn to the last two sentences of the article. Mr. McLusky was asking you about how long it would take to reforest sites.

Do you recall those questions?

A. Yes. Yes, I do.

Q. Would you read the sentence beginning with the words "Ultimately, a longer time span." Do you see that?

A. "Ultimately, a longer time span and subsequent monitoring will be required to determine if and when conditions improve and whether newer surface mining methods and required

compensatory mitigation will minimize adverse ecological effect and speed recovery in streams draining mountaintop mining/valley fill in the Central Appalachians. However, if dissolved ion concentrations are not mitigated with these newer mining practices, recovery of macroinvertebrate assemblages is doubtful."

Q. Do you agree with that conclusion?

A. Absolutely.

Q. So as I understand it -- well, strike that.

Do Suter and -- well, I guess this is Pond. Pond does find that there's a relationship between forests and the macroinvertebrate makeup, right?

A. I'm sorry. I was --

Q. This paper, Pond finds that there is a relationship between forested streams and the macroinvertebrate --

A. Yes.

Q. -- composition, right?

A. Yes.

Q. But there's no indication, is there, here or anywhere else that the loss of those forests are the cause of the impairment?

A. That's correct.

Q. I think next Mr. McLusky turned you to the SAB review, which is at tab 25.

MR. MCLUSKY: Is that Joint?

MR. LOVETT: It's PE. Well, let's see. PE 400 is the page number.

THE WITNESS: Okay.

THE COURT: I think that's Plaintiffs' Exhibit 25.

MR. LOVETT: Plaintiffs' Exhibit 25.

BY MR. LOVETT:

Q. And he asked you -- he pointed you to the passage, the first bullet point, "Conductivity itself is not a pollutant, but is a surrogate measure for the major constituent ions in the mixture."

Do you remember --

A. Yes.

Q. -- testifying about that? And I think you agreed with that sentence when he asked you questions about it, correct?

A. I did.

Q. Were you intending to express a legal conclusion about what a pollutant is?

A. No.

Q. Okay. You don't know the law about what a pollutant is, do you?

A. No, I don't know the legal definition.

Q. And that the conductivity is a measure of constituent ions, correct?

A. Yes, it is.

Q. And among those ions are sulfates, right?

A. Yes.
Q. And we saw your testimony earlier that sulfates were very high at Stillhouse, right?
A. Extremely high, in the thousands.
Q. Now, let's turn to Joint Exhibit page 371, which is tab 58. I don't know why -- it took us to 371 because it has the table of contents.
Anyway, is this exhibit the benchmark?
A. Yes, it is.
Q. Okay. On page JE 408, part of the benchmark, Mr. McLusky asked you a question in a section that's 5.3, Treatment of Mixtures. Do you see that section?
A. I do.
Q. "However, conductivity per se is not the cause of toxic effects" --
A. Yes.
Q. -- "and waters with different mixtures of salts but the same conductivity may have different toxicities."
Do you see that?
A. Yes, I do.
Q. It says, "In this case, the benchmark was calculated for a relatively uniform mixture of ions in those streams that exhibit elevated conductivity in the Appalachian Region."
Do you see that?
A. Yes.

Q. Okay. So what does the benchmark mean when it says that conductivity per se is not the cause of toxic effects? What does "per se" add to that?

A. It means that while conductivity is a measure of ionic strength, it's actually the ionic concentration that causes the problem.

Q. So it would be the sulfates that cause the problem; is that correct?

A. That's correct.

Q. And when you see high conductivity levels, you know -- in the Appalachian region, you know that there's going to be impairment because of the ions contained or marked by that conductivity, right?

A. That's correct.

Q. Okay. At PE -- at plaintiffs' exhibit in tab 3 in plaintiffs' notebook, which is a Cormier and Suter paper from 2012 that Mr. McLusky asked about, he turned your attention to PE 93.

A. Okay.

Q. He said -- he had focused your attention on this very last paragraph, the first sentence, "This causal assessment does not attempt to identify constituents of the mixture that account for the effects."

Do you see that?

A. Yes.

Q. Would you read after that, please?
A. "Instead, it shows that the mixture in streams with elevated conductivity and neutral or somewhat alkaline waters in Appalachia can cause and is causing the extirpation of sensitive genera of macroinvertebrates. Laboratory-based physiological evidence suggests that the relative amounts of ions as well as the concentrations of individual ions determine the toxic mechanisms. Failure of bicarbonate media -- mediated regulation of multiple ions in cells, particularly hydrogen, sodium, and chloride, is one potential mode of action."
Q. Thank you.
Sorry to keep changing notebooks on you, Mike. I'm just following the order.
In defendant's notebook, volume 1 of 4, tab 8, Mr. McLusky turned your attention to page 15.
A. Okay.
Q. Bottom paragraph.
A. Yes.
Q. And I think you read this into record already. The first sentence says that in certain waters of the Gauley River, including Stillhouse Branch, the stressor identification process determined ionic toxicity as the primary stressor.
Do you see that?
A. I do.

Q. So this is a DEP document, right?
A. Yes.
Q. So DEP determined, didn't it, that toxicity is the primary stressor in Stillhouse Branch?
A. That ionic toxicity is, yes, they did.
Q. All right. It goes on to say that it's not going to write a TMDL for that, doesn't it?
A. It does.
Q. You don't know why it declined to write that TMDL, do you?
A. I have no idea why.
Q. Okay. But there's no doubt that DEP also agrees with Pond, EPA, and you, is there, based on the first sentence?
A. Based on this, no, there's no doubt.
Q. Now, Mr. McLusky asked you how long the reach of Stillhouse that remains after mining is. Do you recall that?
A. I recall.
Q. And I think he suggested, and you didn't disagree, that it was two or three hundred yards. Is that your recollection?
A. I think we said two or three hundred meters likely, but I wasn't sure.
Q. Now, Twentymile is -- Stillhouse runs into Twentymile Creek, right?
A. Correct.
Q. Twentymile Creek is probably -- the confluence of Twenty-

mile Creek and Stillhouse is probably where the DEP inspector was looking when he started their examination, right?

A. Well, based on the sample --

Q. Okay.

A. -- form, it looks like that.

Q. And there's a stipulation at JE page 129. Could you turn to that stipulation and look at number 15?

A. Okay.

Q. And that says, doesn't it, that both Stillhouse Branch and Twentymile Creek downstream from that branch are listed on the DEP 303(d) --

MR. MCLUSKY: Your Honor, I object. There was no testimony on my cross-examination about Stillhouse -- or about Twentymile Creek at all.

MR. LOVETT: He was making the point, I believe, that there's a very small segment of impaired water in Stillhouse, and my only point is to show that the impairment continues down into --

THE COURT: Well, I think that is beyond his cross-examination.

BY MR. LOVETT:

Q. Mr. McLusky asked you about a series of variables in water that could affect the macroinvertebrate makeup, such as differences in benthic algae and changes in primary production and ponds and so forth. Let me ask you about each of those.

A. Okay.
Q. Let's talk about the differences in benthic algae that come both generally with valley fills and at this particular site. So let's start generally.
Do you believe that generally the differences in the benthic algae that results from mountaintop removal mining or other large-scale surface mining could account for the complete extirpation of mayflies below sites?
A. Absolutely not.
Q. Okay. Do you think that at this site that happened?
A. No, I don't.
Q. Okay. Is there a complete extirpation of mayflies at this site?
A. There is a complete extirpation.
Q. So though differences in algae can certainly, as you testified, affect the benthic macroinvertebrate makeup, that's different from extirpating all mayflies, correct?
A. Yes. Food is important, but it wouldn't lead to the loss of an entire order of organisms.
Q. What would lead to that loss?
A. Typically it's pollution that's the problem.
Q. What about changes in primary production? Is that also something that occurs below large-scale surface mining?
A. Well --
Q. Typically?

A. It may. I mean I'm trying to think who studied it. I believe Fritz and others may have. It certainly could change below mine sites.

Q. Well, the kinds of changes to primary production that could occur below valley fills, would that cause the complete extirpation of mayflies?

A. No.

Q. Okay. What about ponds? You testified that the ponds in the streams affect the macroinvertebrate makeup. Could they be responsible for the complete extirpation of mayflies?

A. No. And, again, I think I noted that the effects of ponds on streams when they flow into them usually are associated with adding some pelagic organisms, organisms that live up in the water column, not extirpation of taxa.

Q. And the flow issue as well, I think that you testified that the flow is slowed by the flume. But even if the flow were increased significantly and reduced the macroinvertebrate community, could that account for the complete extirpation of mayflies?

A. You wouldn't see the complete extirpation unless -- you would have seen -- if the flow was high enough to really lead to loss, you would have seen massive erosion in the channel.

Q. Okay. And he asked you also -- and did you see massive erosion in the channel?

A. No, not at all, and I have seen that in streams.

Q. All right. And then the last thing he asked you about was temperature, and I think you testified earlier -- and I just want to make sure, based on his cross-examination, do you believe that the temperature at that site could cause the complete extirpation of mayflies?

A. No. There's no indication based on annual variation in temperature seasonally that it exceeds the tolerance levels.

MR. LOVETT: I'm almost finished, Your Honor. One second.

THE COURT: All right.

BY MR. LOVETT:

Q. You have the joint exhibits in front of you. I can't remember where we were last.

A. Okay. Yes, I do.

Q. Now, would you turn to tab 9, page 30.

A. Yes.

Q. Do you recognize that picture?

A. I do.

Q. And is that pool up there the kind of -- well, describe that in terms of the flow attenuation that you described earlier at that site to Mr. McLusky, please.

A. Right. So when flow is a problem in streams, the way it's typically controlled is to have a plunge pool, what are called step pools. And that's a natural one, probably due to flow that's fairly high coming down that during storms. And

so what that does is dramatically reduces the flow, and it more slowly moves out of that pool down to the riffle and the stream below.

Q. Okay. So that's the picture of the plunge pool you were talking about.

A. That's right.

Q. Okay. And then, lastly, would you turn to tab 4, JE 25.

A. Okay.

Q. Mr. McLusky asked you if you knew the constituents of the ionic -- the ionic composition of the water at Stillhouse.

Does this table tell you anything about that?

A. Well, sure. It describes the concentration of many of the constituents, but not all of them.

Q. Right. So calcium, is that one of them that I recall?

A. Yes. And that is 207 micrograms per liter in the stream.

Q. And sulfates?

A. Sulfate is 2100 milligrams per liter.

Q. Is that 2100 or 2000? Are we looking at the same thing?

A. Yes, the result. For sulfate?

Q. Are you at JE 25?

A. Yes.

Q. Sulfate?

A. You're looking at the outfall. I'm sorry. Did you want me to look at the outfall?

Q. Oh, let's look at the -- you're right. I'm looking at

the outfall, and you're looking at --
A. I looked at the stream.
Q. Okay. So, though, at both of those sites, the sulfates are extremely elevated, aren't they?
A. Very elevated.
Q. Any other information here about the ionic composition of the water?
A. Well, it shows the manganese dissolved in total as well as nitrates, and both of those are typically elevated below valley fill sites.
Q. Is the sulfates the thing that most stands out here to you?
A. Well, the sulfate and, of course, the conductivity up above --
Q. Right.
A. -- which is a measure of all the ions.
Q. Which is 2800.
A. That's right.

MR. LOVETT: Okay. Thank you. That's all I have.

THE COURT: All right. Recross?

MR. MCLUSKY: No, Your Honor.

THE COURT: All right. Dr. Palmer, you may step down.

THE WITNESS: Thanks, Mike.

THE COURT: Is Dr. King going to be your next

witness?

MR. LOVETT: Yes.

THE COURT: Someone go and get him.

Let me make one request. You've each had witnesses -- or the witness read from various exhibits. I assume that some of those, counsel are going to seek to be admitted. I'm not sure that that's true with all of them.

For the benefit of my court reporter, I'm going to require that you provide at least the page that you've had the witness read from to make sure that she can double check her work, all right?

MR. LOVETT: Your Honor, we have also failed to address the issue of the exhibits.

THE COURT: Do you want to do that now?

MR. LOVETT: It's up to the Court.

THE COURT: Let's do it now.

MR. LOVETT: Okay. So --

THE COURT: Use your microphone there. I can barely hear you.

MR. LOVETT: I move to admit Plaintiffs' 1, Plaintiffs' 3, Plaintiffs' 11, Plaintiffs' 13, 15, 16, 17, 18, 19, 20, 21, 25, 26, and, out of order, 23.

And it's my understanding that we -- I want to make sure I'm right about this, that it's unnecessary to move the admission of joint exhibits because they're already all

admitted.

THE COURT: Well --

MR. LOVETT: Is that the state of the joint exhibits?

THE COURT: First, let's hear the defendant's response to the plaintiffs moving the plaintiff exhibit numbers he just noted into evidence.

MR. MCLUSKY: I think Mr. Harvey is going to respond.

THE COURT: That's fine.

MR. HARVEY: Your Honor, we don't mind if the court reporter has a page of the learned treatises that the plaintiffs have introduced. Under the Rules of Evidence, they're supposed to be read in the record. An exhibit does not come in. But if the court reporter wants to have a page for purposes of typing, we're fine with that, but otherwise we object to the admittance of those exhibits.

MR. LOVETT: I think it's a fair objection, and that's why we read all that into the -- all the testimony into the record. So --

THE COURT: Well, I agree. First, generally learned treatises aren't admitted as exhibits into evidence. Here, obviously the parties have had the witness read or refer to specific pages. I've tried to keep notes of those pages as my court reporter, I'm sure, has gotten them better than I have

to make sure that we know. As far as I'm concerned, I'm going to admit the exhibits insofar as they contain the specific paragraphs or sentences about which the witness was questioned.

I don't believe it's appropriate for the parties or the Court to rely upon anything other than that in any of these exhibits. However, it would be virtually impossible for us to have, I think, a clear record and certainly for the Court to have fair access to these documents to make sure that the Court can accurately recall exactly what the witness referred to.

So to that extent, I overrule the objection. The Court will allow these documents the plaintiff noted to be admitted into evidence but restrict their use to only those portions specifically referred to in the questioning of the witness.

The next question I think was --

THE CLERK: I have two they identified but didn't move.

THE COURT: There are two plaintiffs' exhibits that you haven't identified -- or haven't moved, rather.

THE CLERK: 7 and 14.

THE COURT: 7 and 14 appear to be the exhibit numbers that we referred to.

MR. LOVETT: Let me look at them, Your Honor. I'd also note, though, that 20 and 21 that we moved are not

learned treatises but were letters from EPA.

MR. HARVEY: No objection to 20 and 21.

THE COURT: 21 then are admitted fully.

THE CLERK: 20 and 21.

MR. LOVETT: So did you say Plaintiffs' 7?

THE CLERK: And 14.

THE COURT: My clerk tells me that you referred to and identified in the course of questioning Exhibit 7.

MR. LOVETT: Yes. Did we use that? I don't know if she did.

Okay. The same. We would move Plaintiffs' 7 in the same way that we moved the other ones and subject to the same ruling.

And what was the other one? 14 we did not have any testimony about.

THE COURT: Well, I'm looking through 7. I tried to put brackets around any parts of these articles that the witness read into evidence or that counsel specifically referred to.

I don't see that I made any such markings on Exhibit 7. So I don't know the extent to which she relied upon it in her questioning.

MR. LOVETT: I agree with you, Your Honor. I have none either. I'm relying on co-counsel --

THE COURT: All right. At this point I'm not

admitting anything from Exhibit 7. If you find that somehow we've missed something, we can deal with it later.

MR. LOVETT: Okay.

THE COURT: What about 14?

MR. LOVETT: Nothing in 14, Your Honor.

THE COURT: All right. Then with regard to 7 and 14, neither of those are being moved at this time.

Now, I assume, then, that the parties agree that with respect to the joint exhibits, which you've stipulated as authentic, that the same limitation on their admissibility applies if they are a learned treatise, if they're one of these published articles. So that it's only that portion quoted from or directly referred to in the questioning that is actually admitted into evidence.

MR. LOVETT: Your Honor, I also would like to raise another thing. I think that 25, which is the Science Advisory Board's letter and the comments, are government documents and should be admitted, not only under the --

THE COURT: I think 25 also falls out of the category of simply a learned treatise, and it is a government document, and the Court will admit it.

THE CLERK: Plaintiffs'?

THE COURT: Plaintiffs' Exhibit 25.

MR. MCLUSKY: The benchmark as well?

MR. BECHER: The benchmark is in our joint exhibit

list.

(The Court and Clerk conferred privately off the record.)

THE COURT: As I understand it, with the joint exhibits, even those which you have yet to refer to in any of your questioning, you've stipulated that those are authentic documents.

To the extent that they're a learned treatise, you've agreed that they should be admitted only insofar as a witness is specifically questioned or reads from the treatise. Otherwise, I assume they're admitted for any purpose.

MR. HARVEY: Your Honor, maybe I can clarify. I'm looking at the list of joint exhibits. I don't think any are learned treatises.

THE COURT: Okay.

MR. HARVEY: So I don't think we have an issue there.

THE COURT: All right. So all of the joint exhibits are admitted into evidence for all purposes?

MR. LOVETT: (Nods head up and down)

MR. HARVEY: The ones they've moved, we have no issue with, Your Honor.

THE COURT: Well, they just moved them all. That's sort of the point of bringing it up.

MR. HARVEY: Whether testified to or not?

MR. LOVETT: It was my understanding, Shane, that

that was our agreement, that all of these documents were admissible in full so that we wouldn't have to do that. I can move individual ones if you'd like.

MR. MCLUSKY: There was an agreement they were all admissible, but they would not be admitted unless someone actually relied on them, Your Honor, is what I understood the agreement.

MR. HARVEY: There are figures here from Dr. Prestegaard, who's not testified.

THE COURT: Well, all right. Let's just stop in our tracks. With regard to the joint exhibits thus far, we'll take those up at a later time. Let's get started with Dr. King.

MR. MCLUSKY: Your Honor, I did have -- move three exhibits that we referred to.

THE COURT: All right. Go ahead.

MR. MCLUSKY: That is 5B and 7, both of which I think were photographs. One was -- actually got from the plaintiffs. And then Defendant's 37, which was the DEP site inspection form.

THE COURT: All right. Any objection to those being introduced into evidence?

MR. MCLUSKY: I think that's part of a joint exhibit.

MR. LOVETT: I don't have any -- you said the DEP

was a joint exhibit?

MR. MCLUSKY: The original has more pages. I made a shorter exhibit just for this witness.

MR. LOVETT: I have no objection to anything in the joint exhibit book if it's in there, and I think Mr. McLusky is representing that that DEP document is in the joint exhibit book. I have no objection.

MR. MCLUSKY: It is.

THE COURT: All right. But you're saying that it's not all of --

MR. MCLUSKY: Correct.

THE COURT: -- what is contained in the joint exhibit?

MR. MCLUSKY: Right. It's a shorter exhibit.

THE COURT: All right. So Defendant's 5B, 7, and 37 are admitted into evidence.

You also referred to Defendant's Exhibit Number 8.

MR. MCLUSKY: I'm not --

THE COURT: Not moving that?

MR. MCLUSKY: (Shakes head from side to side)

THE COURT: Just make sure -- I don't know which one that is. If that's one in which you've questioned a witness about a particular statement within the exhibit, make sure you provide a copy of that to my court reporter.

MR. MCLUSKY: Will do.

THE COURT: All right. All right. Ready for Dr. King?

MR. BECHER: Yes, Your Honor. Plaintiffs would next call Dr. Ryan King.

THE COURT: We'll go until about five and then we'll stop wherever we are and come back tomorrow.

MR. BECHER: We can at least get Dr. King qualified by then.

THE COURT: Doctor, if you'll step up here, my clerk will administer the oath.

RYAN KING, PLAINTIFFS' WITNESS, SWORN

DIRECT EXAMINATION

BY MR. BECHER:

Q. Good afternoon, Dr. King. If you could, there's a series of notebooks to your left. If you'd open the Joint Exhibits 1 through 58 to tab 24, please.

A. What was the tab?

Q. 24. Do you recognize this document?

A. Yes.

Q. What is it?

A. It's my CV.

Q. Did you prepare that CV?

A. I did.

Q. Is it an accurate representation of your experience to date? You can go through it if you'd like.

A. Yes, although I think it's probably a couple of months out of date, but otherwise, yes.

Q. Okay. Was this the CV you submitted with your expert report?

A. Yes.

Q. Now, have you previously testified in front of this Court?

A. Yes, I have.

Q. And I believe you've been accepted as an expert in aquatic ecology, entomology, and ecological data analysis; is that correct?

A. That is correct.

Q. And as I recall, you prefer to refer to yourself as an expert in ecological data analysis rather than statistics. At least that was the case last time. Is that still the case?

A. Yes, that's correct.

Q. Can you explain the difference between ecological data analysis and statistics?

A. Well, the distinction is that the field of statistics is huge. There are many specializations within the field of statistics; and to claim that I'm an expert in all areas of statistics would be like, you know, claiming I'm an expert in all areas of medicine or something along those lines.

So ecological data analysis deals specifically with the unique idiosyncratic properties of ecological data, which

makes them generally not amenable to traditional or conventional statistical procedures, particularly when you're talking about species assemblages and multiple predictors. And so that's kind of an area that I have a particular expertise. And while I have a strong foundation in conventional statistics, that's my area of expertise.

Q. Thank you. Now, where are you a professor at?

A. Baylor University in Waco, Texas.

Q. Are you tenured there?

A. Yes.

Q. When did you receive tenure?

A. It was in 2009, and then I was just promoted to a full professor this year, which is one of the things that's a little bit outdated on the CV there.

Q. Sure. At Baylor do you teach any courses related to aquatic ecology or entomology?

A. Yes, I do. I teach stream ecology, aquatic biology. I taught a seminar in the taxonomy of aquatic insects, just to name a few.

Q. Have you published in those areas?

A. Yes.

Q. About how many papers have you published in those areas, if you know?

A. The majority of my papers. I mean I've published I guess somewhere in the 50 range of publications, and virtually all

of them deal with, you know, aquatic ecology, entomology, and/or ecological statistics in some way.

Q. Do you run a lab at Baylor?

A. I do. My lab is called the Aquatic Ecology Lab, and I have five graduate students and currently have three full-time technicians and several undergraduate researchers in my lab. So it keeps me busy.

Q. Can you tell us a little bit about the work, some of the research projects your lab is doing currently that might relate to aquatic ecology or entomology?

A. Sure. I mean I have several funded research projects ranging from an NSF project on environmental implications of nanomaterials in aquatic ecosystems. I'm completing a project on atrazine, which was funded directly in response to the EPA Scientific Advisory Panel recommendation for a specific study dealing with pulsed additions of atrazine, and so I was basically contacted as the person to do that. And the results of that study are actually going to play a significant role in the atrazine standard, which is up for renewal in 2015.

Q. Is that like the development of a water quality criteria for atrazine?

A. Absolutely. It's basically they're re-reviewing it. There's been numerous papers that have been published since ten years ago, and now they're trying to determine whether they need to adjust that numerical criterion for non-point

source waters.

Q. Are you currently involved in any other work like that, determining numeric or other criteria for waters?

A. I am. I was just selected -- and arguably this is probably the most important study that I will have conducted to date; been selected by a joint committee composed of governor-appointed scientists from the States of Oklahoma and Arkansas.

I was selected to run an independent stressor response study related to phosphorus as it relates to rivers and streams in Northeastern Oklahoma and Northwest Arkansas. And this study is the culmination of many years of litigation between Oklahoma and Arkansas, which came -- really fully came to a head in 1992 as a Supreme Court case in which it was ruled that an upstream state cannot violate the water quality standards of a downstream state.

And so this particular study is a two-and-a-half-year gradient study. It's all based on field observations, and -- but it is considered a causal analysis. And you're using principles of causal analysis and confounding factors to identify a critical level of phosphorus.

And at the end of the study, the report that will be written by me and agreed upon by the committee will bind the States of Oklahoma and Arkansas to the numeric value that is determined by our study. And that will theoretically end

30-plus years of litigation between the two states.

Q. Now, when you say bind the parties, is this a study you're doing for one particular group, either plaintiffs or defendants?

A. No. The two states have come together in agreement. In fact, they required that it was someone who was outside the States of Oklahoma and Arkansas to run the study independently. They asked for -- requested statements of qualifications; and I had to give a proposal, along with several others, and I was selected to run the study.

Q. Thank you. Now, you mentioned you have submitted -- I think you estimated 50 or so papers or published 50 or so papers in your career. I assume those are to various ecological journals.

A. That's right. I mean primarily to journals that are specific to aquatic ecology or more generally to the broader field of ecology and environmental science.

Q. Do you currently serve as a reviewer yourself on any ecological journals?

A. Well, I get requests frequently to review for journals as an ad hoc reviewer, but I'm a subject matter editor for a journal called *Ecological Applications*, which is one of the flagship journals for the Ecological Society of America.

I previously served as an editor, a subject matter editor on a journal *Freshwater Science* before that. So between

ad hoc reviews and serving as an editor, I review a lot of papers.

Q. Do these papers often deal with ecological statistics or ecological data analysis?

A. Yeah, frequently. I mean that's one of the reasons why I was added to the editorial boards of those journals.

Q. Before coming to Baylor as a professor, where did you work?

A. I worked at the Smithsonian Environmental Research Center in Edgewater, Maryland.

Q. And what was your focus there?

A. Well, it was based on linking land use in coastal areas to stream and estuarine biological conditions. So I did work on small streams, much like the ones that we're discussing now, looking -- using -- used a large chronological monitoring dataset for the State of Maryland and published several papers from that, one of which was a highly cited paper, dealt specifically with potential confounding factors and steps to go about avoiding pitfalls when relating land use to ecological response variables in streams.

I also did some papers in the estuaries related to anything from blue crabs to PCBs and some estuarine fishes and how those related to land use.

Q. Was a lot of this work done with aquatic insects and macroinvertebrates?

A. The stream work absolutely was, yes. It was completely based on aquatic macroinvertebrates.

Q. How many macroinvertebrate assessments do you think you've done in your career?

A. I don't know.

Q. Is it on the order of hundreds?

A. Yes, sure.

Q. Have you published or developed any materials specific to ecological data analysis?

A. I have. I've co-authored papers earlier in my career on changepoint analysis, but most recently I have published several papers about a technique called Threshold Indicator Taxa Analysis, or TITAN. And we've published not only the method but some applications of the method and some clarifications and guidance on how to use the method.

Q. And is that technique now used more broadly in the field than just yourself and your co-developers?

A. Yes, absolutely. I think since we published it in 2010, it's been used in about 60 papers; and we get requests frequently for help on, you know, guidance on how to use the method. And it's even being employed by, for example, Connecticut and Massachusetts in some of their biological condition work, and even USGS in the Northeast has been using it. So I'm aware of others as well, but those are some examples of groups that are applying the technique.

Q. Now, this case involves questions about relationships between ionic pollution below mines and the degradation of streams. Is that your understanding?

A. Yes.

Q. Have you done any work or published any material specifically in this area?

A. Yes.

Q. Okay. Can you describe that?

A. Well, that was a paper in which I was the co-author with Emily Bernhardt, Brian Lutz, and some others where we looked at a subset of sites that were screened pretty thoroughly to identify a gradient of reference conditions up to very heavily mined areas that were relatively independent of other confounding factors and tried to identify levels of conductivity and mining that resulted in impairment to West Virginia streams. And that was based on the West Virginia database.

That paper is frequently referred to as the "How Many Mountains" paper published in *Environmental Science and Technology*.

Q. Have you kept up to date with further research as it's developed?

A. I have, yes.

Q. Okay. In doing so, have you had pretty thorough exposure to the types of insects that would commonly occur in

Appalachian streams?
A. Yes, absolutely.
Q. Would you say that by looking at a taxa list that you would be able to determine whether those would be common insects to an Appalachian stream?
A. Yes.
Q. Okay. And that would be based, I assume, in your work on the database and your own publication.
A. Yes, absolutely, and in reviewing the increasingly large body of literature that other investigators have published related to this same topic in which they've looked at, you know, various similar but various facets of the relationship between mining and macroinvertebrates.

MR. BECHER: Okay. At this point, I'd move to qualify Dr. King as an expert in aquatic ecology, entomology, and ecological data analysis.

THE COURT: All right. I'm satisfied. You can proceed, and can cross-examine him as to his qualification.

BY MR. BECHER:
Q. Now, you were sequestered during the cross-examination of Dr. Palmer, but you heard her testimony on direct; is that correct?
A. Yes, I did.
Q. Do you believe her testimony is accurate?
A. Yes.

Q. Is there anything you disagree with that she told the Court earlier?

A. No.

Q. I want to go through -- Dr. Palmer testified as to some of the literature that's developed around this subject of ionic pollution and biological degradation, but there were a couple of papers that you cited in your report that I don't believe she's testified about yet.

If you could, bring open plaintiffs' exhibit binder, which is a different binder than the one you have in front of you.

If you could, please open to Plaintiffs' Exhibit 12.

A. Okay. I'm there.

Q. Do you recognize this paper?

A. Yes.

Q. Can you tell me the main points, in your own words, of what this paper finds?

A. Well, this study examined the relationship between both mining and residential and commercial development on biological condition of streams, and they found that streams that had both relatively high levels of development and mining had lower biological condition than streams that had just development or just mining. Hence, there was an additive effect between the two. But they found a very strong relationship regardless of just mining and just development

independently.

Q. Reading in the abstract or looking at the abstract, there's a sentence that begins "Correlation analysis and partial Mantel tests."

Can you read that sentence for me?

A. Sure. "Correlation analysis and partial Mantel tests indicated that mining (percent of total of subwatershed area) caused acute changes in water chemistry (with correlations between .55 and .91), whereas residential development (expressed as parcel density) strongly affected both physical habitat (with correlations between .59 and .81) and macroinvertebrate community structure (with correlations between .059 and .093)."

Q. Thank you. If you could turn to page PE 166. It's the same study.

A. Okay.

Q. Would you read in the second column the sentence that begins "On average." It's the second sentence in the first full paragraph in that column.

A. PE 166 you said?

Q. Correct.

A. And it's the second sentence in the first paragraph?

Q. The first full paragraph. There's a partial paragraph on top.

THE COURT: The paragraph starting "Along the mining

gradient."

BY MR. BECHER:

Q. "Along the mining gradient." I'd like you to read the second sentence, "On average."

A. Sorry. Excuse me. "On average, a mining intensity of 25.8 percent produced conductivities of 257 microsiemens per centimeter, suggesting a high degree of agreement between mining and specific conductance for the observed biological impairment."

Q. And actually going back to the sentence that begins at the bottom of the first column, can you read that for me?

A. Starting with "Given that"?

Q. Exactly.

A. "Given that specific conductance was the major stressor associated with mining, we repeated this process using the linear relationship between specific conductance and WVSCI, (an R-square of 0.36)."

Q. Okay. I'd like to turn the page to 167 where the discussion section begins.

A. Okay.

Q. And I apologize for the time it may take, but can you read the first two paragraphs in the discussion section?

A. Okay. "We found significant effects of mining on in-stream conditions. Increased levels of mining resulted in poorer water quality, primarily through increases in specific

conductance and associated dissolved chemical constituents (that is, sulfate, calcium, magnesium, sodium, and nitrate). Selenium concentrations exceeded US EPA water-quality standards in several mined sites. However, no relationship was observed between selenium and total percent mining. Mining also resulted in significant alterations to macroinvertebrate community structure through decreases in sensitive taxa (that is, EPT richness, E richness, and percent E), and Ephemeroptera consistently showed the greatest decline. These alterations led to significant decreases in WVSCI score. Mining had no measurable effect on habitat complexity or quality."

Continuing on to the second paragraph, "Our results are similar to those of recent studies that have identified changes in water quality to be the dominant stressor in mined systems. Increased specific conductance is consistently the dominant stressor in streams affected by mountaintop removal mining in southern West Virginia. Hartman et al. (2005) observed conductivities in mined sites that were 2 to 21 times higher than those observed in reference sites. Furthermore, increased specific conductance is a consistently important predictor of ecological condition in these systems. Pond et al. (2008) used specific conductance as an indirect measure of mining intensity and noted a significant response in 17 of 19 community metrics. Our results corroborate those of

numerous studies in which Ephemeroptera was identified as one of the most sensitive taxa to increases in ionic strength associated with large-scale surface mining in the central Appalachian region."

Q. So what are they suggesting is the mechanism by which mining is causing changes to these ecological systems?

A. Well, they're suggesting that the mixture of ions is -- that constitute specific conductance or conductivity, as we usually refer to it in some of these other papers, is having a direct effect on aquatic macroinvertebrates, particularly mayflies, and that it's independent of many of these other factors that you might normally associate with degradation and biological impairment.

Q. Thank you. Actually I want you to read one more part of this paper, the bottom of PE 168, the very last sentence on that page.

A. "The threshold changes from mining observed in our study were highly consistent with observed threshold changes along the specific conductance gradient."

Q. Okay. And keep going on to -- excuse me. In 169 are a number of graphs. But if you could, please, go on to 170.

A. "Consequently, conductance may be a reliable single indicator of coal-mining influence on aquatic ecosystems. Our results are similar to those of Pond et al. (2008) who observed a high frequency of impairment when conductance was

greater than 500. Values greater than 500 in our study corresponded to the 95 percent impairment thresholds for total mining and specific conductance. Conversely, Pond et al. (2008) observed no impairment in WVSCI when conductance was less than 500. We observed biological impairment when conductance reached 250 microsiemens per centimeter, suggesting that impairment may occur at lower conductance in Pigeon Creek than previously reported."

Q. And as I believe you said before -- correct me, but this is suggesting that the ions associated with conductivity in these -- from these mines is what's causing biological impairment?

A. That's my -- yeah, absolutely.

Q. Do you agree with that?

A. I do.

Q. If you know -- or if you don't, turn to the first page of the study. Where is this published?

A. It's the *Journal of the North American Benthological Society*, which is now called *Freshwater Science*.

Q. Is that the journal that you formerly were serving on as a reviewer?

A. Yes.

Q. Okay. And is that a reputable journal?

A. Yes. It's considered probably the best journal for stream ecology.

Q. Okay. If you could now please turn to Plaintiffs' Exhibit 14.

I apologize, Your Honor. Let me get my bearings here for a moment.

THE COURT: That's all right.

MR. BECHER: If I could have one second, Your Honor.

THE COURT: Go ahead.

BY MR. BECHER:

Q. I might skip this study. I will have you turn -- I want to clarify something that was brought up earlier. If you could turn to the Pond 2008 study, which is the next tab, Plaintiffs' Exhibit --

A. Okay. I'm there.

Q. Okay. Can you read on the bottom of page 211, PE 211, the sentence that begins with "Our bioassessment indicators." It's about two-thirds of the way down the last paragraph on page PE 211.

A. "Our bioassessment indicators were not strongly correlated with dissolved or total metals concentrations in the water column, but these results do not rule out possible exposure to metals via dietary uptake or microhabitat smothering by metal hydroxide precipitate."

Q. Thank you. And are you familiar -- I should have asked this first. Are you familiar with this Pond 2008 paper?

A. I am.

Q. There was a lot of testimony about this paper from Dr. Palmer. I don't want you to re-read Dr. Palmer's sections, but are you familiar with the main findings of this paper?

A. Yeah. I mean the gist of it is that they set up a study that was basically a gradient study but done in groupings based on conductivity where they selected a series of unmined and then mined sites with valley fills where they sampled below the valley fills and examined a variety of different biological metrics, including some multivariate approaches but also multi-metric indices such as WVSCI and GLIMPSS.

And what they found was a very strong relationship between conductivity associated with alkaline mine drainage and both WVSCI and the GLIMPSS scores. And this is an example of a dataset where the conductivity data was collected for -- I believe it was monthly for about a year, maybe 13 collections. And so there was more certainty in the conductivity data versus, for example, the DEP dataset where we have just one measurement, and we know that conductivity kind of bounces around.

And, you know, so to the point that the relationship between conductivity and WVSCI and the DEP dataset is weaker, one of the things that this study shows is it's attributed probably a lot to the fact that conductivity varies over time. When we have better conductivity estimates, you end up

explaining a lot more variance in the WVSCI scores and in the GLIMPSS scores. I believe it was up to 80 percent of the variance was explained.

Q. Okay. Thank you. And so this was looking at the, again, the relationship between conductivity and biological degradation --

MR. HARVEY: Your Honor, I hate to object at this late hour especially, but this is cumulative. We covered all this with Dr. Palmer.

MR. BECHER: I just want to make one point here.

BY MR. BECHER:

Q. Are you familiar --

THE COURT: Overruled. Go ahead.

BY MR. BECHER:

Q. Are you familiar with the main constituents of conductivity in alkaline mine drainage in West Virginia or in the Appalachian streams?

A. Yes. Bicarbonate, sulfate, calcium, magnesium.

Q. Are most of those metals?

A. Metals?

Q. Yes.

A. No.

Q. Which ones are not metals?

A. Well, bicarbonate and sulfate and calcium.

Q. Okay. And so when Pond is saying, as you read, "Our

bioassessment indicators were not strongly correlated with dissolved or total metals concentrations," that's not saying anything about the relationship with sulfates, bicarbonates, or calcium; is that correct?

A. No, I don't read it that way.

Q. Okay. Well, how do you read that? Let's be clear.

A. My understanding is he's referring specifically to metals that were -- represented much smaller, lower concentration of the total -- that represented virtually no signal in the conductivity signal. They may be part of this.

Q. So this is a separate finding from his conductivity finding?

A. Yes.

Q. Thank you. Okay. And I just want to ask generally -- this is the Pond 2008 paper that you've testified about and Dr. Palmer testified about. Are you familiar with other work by Greg Pond?

A. Yeah, absolutely. He's published a series of papers, you know, recently, particularly focused on mayflies. And then he has a really important paper that just came out in 2014 in *Environmental Management* that has several findings that have major implications to sort of rule out some of the loose ends that have been presented as confounding issues in this relationship between conductivity and biological condition.

Q. And, again, avoiding cumulative testimony -- I think

we'll get in some new things in the 2014 paper in just a second -- but is there any outcome from Pond's or others' works that you can say is indicative of mines degraded by conductivity?

A. Is there any -- his specific findings were relative --

Q. Yes, is there any -- so he does a lot of work, say, in his 2008 paper looking at biological indices versus -- well, looking at biological indices and their effects by conductivity. He does other work which furthers that research. Does he find any kind of marker for streams that are degraded that shows that this is a signature effect of conductivity?

A. Well, what he finds is essentially what is continuing to be this almost a mountain of literature now that repeatedly shows a series of taxa, mostly mayflies, that are highly sensitive to conductivity associated with surface mines.

He specifically goes into examining a list of sensitive taxa, some of which we published as sensitive taxa in our "How Many Mountains" paper. In fact, he cites our paper and refers to it directly and basically says his results are highly congruent with what we found in that paper and also what the EPA found in their benchmark.

And what's important in his study is that it's another example of a -- rather than using the existing dataset for biomonitoring at the state level, they did a very carefully defined gradient study by going out to valley fills that were,

in fact, between 11 and 33 years old.

One of the questions was, do these older valley fills start to show a sign of diminished conductivities and then relates that to -- or compares that to sites that are unmined. So, in essence, the key findings were that there was no evidence that --

MR. HARVEY: Your Honor, if I may, this is hearsay. If he wants to read parts of Mr. Pond's study that he's relying on, he may, but to simply spout out what he thinks it says is hearsay.

THE COURT: Well, I disagree. I think what he's trying to establish is the basis for his conclusion where he agrees with these findings.

Go ahead.

THE WITNESS: Yeah. I'm simply summarizing the fact that here's a dataset that was collected independently of previous datasets, and they found essentially the same thing, that they analyzed the data in a different way, yet repeatedly come to the same conclusion. And one of those conclusions are that habitat was not an important component of this relationship and that distance from the valley fill was not important, which gets to the issue of, like, well, headwaters, how close to the valley fill we are. In the specific causation in this case, they found no relationship with distance in that particular study.

BY MR. BECHER:

Q. Let's go ahead and turn to Pond's 2014 study at tab 19. If you could, I'd like you to turn to PE 294.

A. Okay.

Q. Can you tell me what this chart on -- I believe it's labeled table 3 -- represents?

A. All right. Well, it's the frequency of occurrence of the top 10 taxa depicted as responding negatively or positively based on differences between the reference and valley fill groups.

So the group on the left are ones that are sensitive, and the ones on the right are ones that are really tolerant or increasers. And the list of names here look very familiar.

Q. Can you read for me the names of the taxa that he's identified as sensitive to conductivity?

A. Yeah. *Ephemerella*, which is a mayfly; *Epeorus*, which is a mayfly; *Neophylax*, which is a caddisfly; *Paraleptophlebia*, which is a mayfly; *Cambarus*, which is a crayfish; *Stempellinella*, which is a chironomid and ordered dipteran; *Maccaffertium*, which is a mayfly; *Oulimnius*, which is an elmid beetle; *Polypedilum*, which is a chironomid. *Yugus*. I'm blanking out on that one. *Haploperla*, which is a stonefly. *Drunella*, which is a mayfly. *Pteronarcys*, stonefly. *Sweltsa*, stonefly.

Q. And those are the ones, again, that are sensitive to

conductivity or they can be expected to decline in high conductivity waters.

Can you read the other column and tell me what those represent.

A. Okay. *Hydropsyche*, which is very commonly associated with mine sites. That's a caddisfly. *Eukiefferiella*, which is a chironomid. *Cricotopus*, chironomid. *Hemerodromia*, which I believe to be a tipulid. *Diamesa*, chironomid. *Neoplasta*. That's probably a name change I don't recognize. *Chimarra*, which is a very tolerant caddisfly. *Lumbricidae*, which is an aquatic worm. *Paratrichocladius*, which is also a chironomid. *Thienmanniella*, chironomid. *Tvetenia*, chironomid. *Chrysops*, which is a tabanid, a deer fly. Those are really nasty, biting deer flies. And *Cheumatopsyche* is also a very tolerant caddisfly.

Q. Thank you. And you said this list looked familiar. Why is that?

A. Well, the names on both sides, while they don't line up perfectly with what we found previously in the "How Many Mountains" paper or the list of the most sensitive that came out in the benchmark document, the majority of these names are ones that we see over and over again as either sensitive or tolerant, respectively, particularly noting that there's a lot of mayflies in the group on the left. And on the right, there's some tough caddisflies. And then there are a lot of

really tolerant midges, chironomids, dipterans.

Q. And let's go ahead and turn to your "How Many Mountains" paper. It's tab 2 in the joint exhibits.

You actually may be able to find this more quickly than I, but I'm looking for your -- well, first of all, did you do a similar list of taxa that would be affected by conductivity, either --

A. Yes, and they're presented in a graph that's the output from the TITAN analysis, which essentially is on page PE 24, figure 3. Unfortunately, the journal was rather chintzy with the figure sizes and so the font is rather small.

MR. MCLUSKY: Your Honor, I'm not objecting, but I think this is Plaintiffs' 2, not Joint Exhibit 2, for those trying to follow.

MR. BECHER: I'm sorry, Your Honor.

THE COURT: I think you're right. It is Plaintiffs' Exhibit Number 2.

BY MR. BECHER:

Q. I understand you have -- what I'm going to try to do here is have you read through a similar list. I'd like to save your eyes and try to keep from you having to read that.

Does that appear anywhere in your supplemental materials in a more legible form?

A. I honestly don't recall. Probably, but --

Q. You can take a quick look. Your supplemental materials

are immediately after the --

THE COURT: Well, if you have something you want to refresh his recollection about his supplemental materials, go ahead.

THE WITNESS: Yeah, we do produce -- we did produce scatterplots of each taxa, which was done so that people could actually see the relationship of taxa response to conductivity one at a time. And so that does start on, I believe, PE 48.

BY MR. BECHER:

Q. These are PE 48. Read the heading on that for me.

A. "Abundance patterns for individual data determined by TITAN to respond negatively to the stream" -- oh, "sulfate concentration gradient." My apologies.

Q. Can you go ahead and tell me which --

A. So I believe the taxa --

Q. -- responds negatively to sulfates based on your work "How Many Mountains."

A. I'm sorry, Mike?

Q. Can you read for me the taxa that you found to respond negatively to sulfate in your "How Many Mountains" work?

A. Okay. *Acroneuria*, which is a stonefly. *Ameletus*, which is a mayfly. *Amphinemura*, which is a stonefly. *Baetis*, which is a mayfly. *Bezzia*, which is a dipteran. *Chrysops*, which is a dipteran. *Cinygmula*, which is a mayfly. *Demicrypto-chironomus*, which is a chironomid, a dipteran. *Dicranota*,

which is a tipulid dipteran. *Diploperla*, which is a stonefly. *Drunella*, which is a mayfly. *Epeorus*, which is a mayfly.

So already several of these names are the same as what we were just reading.

Ephemera, mayfly. *Ephemerella*, mayfly. That was on the previous. *Eurylophella*, mayfly. *Haploperla*, stonefly. *Heptagenia*, mayfly. *Heptageniidae*, which is a group of species, mayfly. *Hexatoma*, which is a stonefly. *Lanthus*, which is an odonate, a dragonfly. *Leptophlebiidae*, which is a mayfly. *Limnophila*, which is a dipteran. *Maccaffertium*, which is a mayfly.

Micropsectra, which is a chironomid. *Microtendipes*, chironomid. *Neophylax*, also on that previous list, is a caddisfly. *Paraleptophlebia* is a mayfly. *Periodidae* is a stonefly. *Platysmittia* is a chironomid, dipteran. *Polypedilum* is a chironomid, dipteran. *Remenus* is -- I'm blanking out on that taxon. *Stenacron* is a mayfly. *Stenonema*, mayfly. *Sweltsa*, stonefly. And *Yugus*, again, is the other that I had just blanked out on.

So a lot of names that were -- and quite a few more here.

Q. You have more than 10.

A. Yeah. He just picked the 10 most, and just to simplify it, rather than list them all.

Q. And he was looking at taxa that would decline as a result

of ionic pollution from mining, right?

A. Yes, he was.

Q. And you were looking at the taxa that would decline directly related to sulfate concentrations.

A. Yes. So we looked at -- compared how the ones -- if we looked at -- just looked at sulfate, which is, you know, one of the primary constituents of alkaline mine drainage, and whether or not those taxa were the same as the ones we saw associated with conductivity, and the correspondence was very high.

Q. Were many of the taxa that you found responding negatively to sulfate the same taxa that Pond found responding negatively to ionic stress or ionic pollution in general?

A. Yes.

MR. HARVEY: Your Honor, again, Dr. King's report does not say that sulfate is the cause of impairment. He says it's conductivity. I'm not sure where this is going, but it seems well outside the scope of his report.

MR. BECHER: I think he said that sulfate is one of the main constituents of conductivity.

THE COURT: He did. Overruled.

BY MR. BECHER:

Q. And this will be much quicker, thankfully, if you could turn to PE 52. And can you read for me the taxa that you found actually respond positively to stream sulfate.

A. Yeah. *Cardiocladius* is a very tolerant chironomid, midge. *Cheumatopsyche*. We've heard that name a lot. That's a caddisfly. *Hydropsyche* is a caddisfly. And then some ambiguous taxa that were grouped as *Hydropsychidae* also increased with sulfate.

Q. And, again, does your finding with regard to sulfate correspond to any of the same taxa that Pond found increased with ionic pollution?

A. Yeah. These are -- these were all, I believe, listed in his group. And then when we looked at this with respect to specific conductance, we have a longer list and more overlap with his list.

Q. Why do you think there's this correlation between sulfates and the group that Pond looked at with ionic --

A. Well, it's -- I mean it is just a predictive chemical component, part of the mixture of the ions that are associated with alkaline mine drainage. So, you know, conductivity is measuring sulfate as well as bicarbonate, calcium, and so forth. And sulfate is just very highly correlated to it because it's part of it. So this is one -- one ion that's a subset of it.

Q. Briefly -- and I won't have you read this, but if you could turn to Joint Exhibit tab 58. Turn to a couple of the very last pages, starting with JE 525.

A. JE 525? You say JE 525?

Q. Correct.
A. So 58 is split between two --
Q. Those are the last few pages of the first ones of the joint exhibits.
A. Okay. I'm there.
Q. Are you familiar with this table?
A. Yes. I've looked it over.
Q. And what is this?
A. These are the extirpation concentrations that were derived by EPA as part of the field-based benchmark for the different genera in ecoregion 69 and 70 of West Virginia.
Q. And what does the column XC95 indicate?
A. That is -- XC95 means extirpation concentration and where 95 percent of the occurrences of the taxon fall at or below that value. So above that value is -- it's essentially the taxon is no longer present.
Q. Okay. And I won't go through all of these ad nauseam, but I just want to pick a few that Pond recognized as responding particularly negatively to conductivity.
Let's look at *Ephemerella*. And I'll tell you, these are in alphabetical order by genus.
A. Okay.
Q. What is the extirpation for this?
A. 299.
Q. Is that relatively low compared to other numbers in this

table?
A. Well, I mean it varies. I mean there are several that are right around that, and then there are some that are much higher.
Q. Okay.
A. But, yeah, it's in the lower 20 percent of the numbers on that table.
Q. How about *Epeorus* or E-p-e-o-r-u-s?
A. *Epeorus* is 307.
Q. Okay. It's around the same level as --
A. Uh-huh.
Q. And to contrast those, let's look at some of the species that -- or, excuse me -- genera that Pond found would respond positively. How about *Hydropsyche*?
A. Yeah. *Hydropsyche* is given a value of -- a conductivity value of greater than 7010 microsiemens per centimeter. So essentially what that means is, it sort of -- they didn't have any more values to look at, and it's at least that much. It could be higher.
Q. And let's go ahead and look at -- I think it's the third one, the Diptera species, *Cricotopus*.
A. Yeah. So *Cricotopus* is greater than 11,227 microsiemens per centimeter. Again, they didn't have any more values. So that's the minimum. It could be much higher, its extirpation concentration.

Q. So the same taxa that Pond found responding negatively are many of the same that you found responding -- let me strike that.

The same taxa that Pond found responding negatively to conductivity and you found responding negatively to sulfates, EPA here is finding are very sensitive or relatively sensitive to conductivity while the ones that responded positively are very tolerant?

A. Yeah, that's right.

Q. Were these investigations done with the same datasets?

A. The Pond data, it was done with -- the Pond study was done with an entirely different dataset that his group collected, though the "How Many Mountains" paper is a subset of the West Virginia DEP dataset, a much smaller subset, but -- and it was screened differently than the dataset here. And then the EPA benchmark document included all of West Virginia's database that was in ecoregion 69 and 70, as well as EPA Region 3 data, which was a relatively small dataset.

Q. Despite these different datasets, are these results consistent?

A. Yeah, remarkably so.

MR. BECHER: Your Honor, it's just about 5:00. This is a good stopping point.

THE COURT: All right. Dr. King, you may step down. Don't discuss your testimony with anyone. We'll recess until

9:00 tomorrow.

Is there anything we need to address before we depart?

MR. HARVEY: Not from defendants, Your Honor.

THE COURT: If not, see you back here at 9:00 in the morning.

(Proceedings adjourned at 5:00 p.m.)

I N D E X

Defendant's Exhibits

I, Teresa M. Ruffner, certify that the foregoing is a correct transcript from the record of proceedings in the above-entitled matter.

/s/Teresa M. Ruffner September 15, 2014